UNDERGROUND STORAGE TANK SITE 2296
GROUNDWATER AND BIOSPARGING MONITORING REPORT
APRIL 2005

MARINE CORPS BASE
CAMP PENDLETON, CALIFORNIA

Prepared For

NAVAL FACILITIES ENGINEERING SERVICE CENTER
1100 23rd Avenue, Port Hueneme, CA 93043-4301

and

NAVAL FACILITIES ENGINEERING COMMAND - SOUTHWEST DIVISION
1220 Pacific Highway, San Diego, CA 92132-5190

Contract number N47408-98-C-7500

15 JULY 2005

Prepared by

PARSONS
100 West Walnut Street
Pasadena, California 91124

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LIST OF ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
BS	biosparging
BSMP	biosparging monitoring point
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CO_2	carbon dioxide
DO	dissolved oxygen
EPA	US Environmental Protection Agency
Fe(II)	ferrous iron
Fe(II)	ferric iron
gpm	gallons per minute
HDPE	high density polyethylene
HP	horse power
LCS/LCSD	laboratory control standard/laboratory control standard duplicate
LEL	lower explosive level
LUFT	leaking underground fuel tank
MCB	Marine Corps Base
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MTBE	methyl tert-butyl ether
mV	millivolt
NFESC	Naval Facilities Engineering Service Center
OHM	OHM Remediation Services Corp.
ORP	oxidation reduction potential
O&M	operation and maintenance
O_2	oxygen
PID	photo-ionization detector
QA	quality assurance
QC	quality control
RWQCB	Regional Water Quality Control Board
SAM	Site Assessment and Mitigation
SPLP	Synthetic Precipitation Leaching Procedure
SWDIV	Southwest Division Naval Facilities Engineering Command
SVOC	Semi-volatile organic compound
TBA	tertiary butyl alcohol
TPH-D	total petroleum hydrocarbons as diesel
TPH-M	total petroleum hydrocarbons as motor oil
TVH	total volatile hydrocarbons
UST	underground storage tank
µg/L	micrograms per liter

SECTION 1

INTRODUCTION

This groundwater monitoring report was prepared for underground storage tank (UST) Site 2296, located at Marine Corps Base (MCB) Camp Pendleton, California. Parsons prepared the report for the United States (U.S.) Navy.

The groundwater monitoring work conducted at the site, as well as the associated reporting activities, are performed for the U.S. Navy, Naval Facilities Engineering Service Center (NFESC) on behalf of the Naval Facilities Engineering Command, Southwest Division (SWDIV) under contract number N47408-98-C-7500. The report is prepared in accordance with direction from the U.S. Navy and with recommendations from the California Regional Water Quality Control Board (RWQCB), San Diego Region. In addition, the groundwater monitoring is performed in accordance with the County of San Diego Site Assessment and Mitigation (SAM) Manual (County of San Diego, 2002).

This introduction (Section 1) contains project and site background information. Section 2 contains sampling and analysis protocol and procedures. Section 3 summarizes sampling results. Section 4 contains conclusions and recommendations. Section 5 contains references cited. Appendix A provides historical groundwater elevation and analytical data. Appendix B contains groundwater sampling sheets and waste manifest forms. Appendix C contains laboratory analytical results from the latest sampling event. Appendix D contains RWQCB meeting notes from February 10, 2005.

1.1 SCOPE OF WORK

Groundwater monitoring is a component of the scope of work from the U.S. Navy for the assessment and remediation of hydrocarbon-impacted soil and groundwater at the Building 2296 maintenance facility. This monitoring includes measurements of groundwater levels and the collection and analysis of groundwater samples. In addition, this report discusses the impact on groundwater concentrations from the biosparging (BS) system that commenced operation in March 2001.

The groundwater samples are analyzed for total petroleum hydrocarbons as diesel (TPH-D). Analysis for total petroleum hydrocarbons as motor oil (TPH-M) was discontinued in July 1999 because detected concentrations were at trace levels consistently below TPH-D concentrations. Samples collected this monitoring event were also tested for the presence of semi-volatile organic compounds (SVOC), in accordance with a request by the RWQCB. Analysis for benzene, toluene, ethylbenzene, and total xylenes (BTEX) was discontinued in April 2000 because concentrations were at trace levels. Samples collected in October 2000 and from MW2296-4 in October 2001 were also tested for the presence of methyl tert-butyl ether (MTBE), other oxygenates, and the degradation product tertiary butyl alcohol (TBA) to meet updated requirements of RWQCB for site closure; none were detected, and analysis for these compounds has been discontinued.

1.2 SITE BACKGROUND

MCB Camp Pendleton is located on the coast of northern San Diego County, California, and covers approximately 125,000 acres (Figure 1-1). Site 2296 is located in the southeast portion of MCB Camp Pendleton, near the intersection of "C" Avenue and 8th Street, and about 700 ft southeast of Vandegrift Boulevard (Figure 1-2). Building 2296 is an active maintenance facility. The former 1,000-gallon, single-walled concrete, diesel UST, was located approximately 20 feet from the northern side of the maintenance buildings. The UST was removed in July 1994. Figure 1-3 presents a detailed site layout.

1.3 PREVIOUS INVESTIGATIONS

In 1994, soil investigations of the site were initiated. In 1995, Brown and Caldwell collected groundwater samples for laboratory analyses. These investigations indicated that (1) petroleum hydrocarbons had been released from the underground storage tank and/or associated piping and (2) soil and groundwater had been impacted.

In 1997 subsequent investigations further delineated the nature and extent of contamination at the site:

- TPH-D was present in both the soil and the groundwater.
- BTEX compounds toluene, ethylbenzene, and total xylenes were present in the soil.
- Toluene and xylenes were present in the groundwater.

1.4 GEOLOGY AND HYDROGEOLOGY

Site 2296 is located on a terrace above the Santa Margarita River bed. The site is underlain by Quaternary alluvial deposits of the Santa Margarita River. The shallow soils consist of silt with varying amounts of fine sand. The backfill in the cavity of the former UST 2296 extends to a depth of approximately seven feet below ground surface (bgs). Figure 1-4 presents a geologic cross-section that also illustrates the historical minimum and maximum groundwater levels and approximate extent of soil contamination in October 1997 and November 2000. The cross-section location is shown on Figure 1-3.

The groundwater beneath the site flows primarily to the southwest but the flow direction has shown variability over time, ranging from northwest to southeast. The hydraulic gradient beneath the site is relatively flat, ranging from 0.002 to 0.01. Pump tests conducted in one of the monitoring wells indicate that the hydraulic conductivity at the site may range from approximately 1.4×10^{-2} to 9.4×10^{-3} centimeters per second (OHM Remediation Services Corp. (OHM), 1998). The nearest groundwater production wells are 10S/52-13R2, located 3,000 feet up-gradient, and 10S/5W-23J1, located 4,200 feet downgradient. Calculations of capture zones indicate that Site 2296 is approximately 1,700 feet away from the edge of the 10S/5W-23J1 capture zone.

1.5 CLEANUP GOALS

The groundwater cleanup goals are identified in Table 1-1 and correspond to drinking water Maximum Contaminant Levels (MCLs) for BTEX compounds and MTBE and secondary MCLs for TPH-D. Cleanup goals were developed for soils based on a dual

standard of leachable concentrations and soil concentrations. Cleanup goals were detailed in the *Final Remediation Work Plan for Underground Storage Tank Site 2296* (Parsons, 2000a) and modified for MTBE in groundwater according to the response to RWQCB comments (Parsons, 2000b).

1.6 BIOSPARGING SYSTEM

A BS system was installed at Site 2296 in accordance with the *Remediation Work Plan* (Parsons, 2000a), as approved by the RWQCB in a meeting on July 20, 2000. Five BS wells (BSW2296-1 through BSW2296-5) and two nested BS monitoring points (BSMPs) (BSMP2296-1 and BSMP2296-2) were installed. The system commenced operation on March 28, 2001. A letter report containing installation and startup results was submitted at a later date to the RWQCB on August 8, 2001 (Parsons, 2001a). The RWQCB responded with comments on April 30, 2002. After submittal of a response dated June 25, 2002, the RWQCB responded on August 6, 2002, that they had no additional comments at this time. The *Remediation Verification Sampling Work Plan* (Parsons, 2002) was submitted to the RWQCB on October 29, 2002.

During a meeting on February 10, 2005, the RWQCB agreed to shutdown the BS system for one year to see if TPH concentrations stabilize (see Appendix D). The system remained shutoff as of March 17, 2005.

1.7 VERFICATION SAMPLING

During February 2003, Parsons conducted remediation verification sampling at Site 2296, in accordance with the *Remediation Verification Sampling Work Plan* submitted in October 30, 2002 (Parsons, 2002) and approved by the RWQCB. The remediation verification sampling proceeded on the basis that the BS system that commenced operation in March 2001 had operated almost two years, and respiration tests conducted during 2002 indicated a low oxygen utilization rate.

The February 2003 confirmation soil sampling locations and results are illustrated on Figure 1-3. The results are also detailed in Table 1-2 (shown in bold) and are listed next to historical results collected at similar locations and depths for comparison. The estimated volume of soil containing petroleum hydrocarbon waste remaining in situ based on the latest 2003 soil sampling results is approximately 67 cubic yards, assuming contamination remains within a 15 by 40 foot area within the street at a depth of 9 to 12 feet bgs.

The 2003 soil boring TPH-D results were generally lower than the historical borings collected prior to BS. Average historical concentrations were calculated and compared to the 2003 soil confirmation results, as shown in Table 1-3. The average reduction in soil TPH-D concentrations near the capillary fringe ranged between 21% and 99% after the two years of BS operation. This apparent variance in removal may be due in part to the discrete nature of soil sampling, and hence an average reduction was calculated for the site. The average reduction in soil TPH-D concentrations for the entire site was 48%.

Soil concentrations of BTEX, MTBE, and other oxygenates were analyzed at four locations. BTEX, MTBE, and other oxygenate results were non-detect in all soil samples for each of these compounds. Synthetic Precipitation Leaching Procedure (SPLP) leachate results were analyzed at SB2296-2. TPH-D was detected in the leachate at 51

milligrams per liter (mg/L). No BTEX, MTBE, or other oxygenates were detected in these samples.

Based on the soil sampling results, it was recommended to continue biosparging through the two BSWs located in the street where residual soil contamination was identified. Based on the need to operate two BSWs rather than five, a smaller 0.75 horse-power (HP) blower was relocated (from Site 53435) to the site, and began operation in November 2003.

The system was again shutoff as of March 17, 2005, to begin a one-year verification monitoring event to see if TPH concentrations stabilize with the BS system off.

Table 1-1

Final Cleanup Goals
MCB Camp Pendleton, California

Constituent	Soil	Groundwater MCL
Benzene	SPLP = ND; Total = 0.1 mg/kg	1 μg/L
Toluene	SPLP = ND; Total = 15 mg/kg	150 μg/L
Ethylbenzene	SPLP = ND; Total = 68 mg/kg	680 μg/L
Total Xylenes	SPLP = ND; Total = 175 mg/kg	1,750 μg/L
MTBE	--	13 μg/L
TPH-D	SPLP = ND (<100 μg/L)	100 μg/L

Notes: Soil cleanup goals assume soil attenuation factor of 100 and undetectable levels of leachable contamination.
MCL for TPH-D is a secondary MCL.
SPLP = Synthetic Precipitation Leaching Procedure.
ND = non-detect.

Table 1-2
Hydrocarbons in Soil at Site 2296
MCB Camp Pendleton, California

Sample ID	Sample Date	Depth	Moisture	Soil							SPLP						
				Diesel	Benzene	Ethyl-benzene	Toluene	Total Xylenes	MTBE, Other	TBA	Diesel	Benzene	Ethyl-benzene	Toluene	Total Xylenes	MTBE, Other	TBA
			D2216	M8015E	8020; 8260	8020; 8260	8020; 8260	8020; 8260	8260	8260	M8015E	8020; 8260	8020; 8260	8020; 8260	8020; 8260	8260	8260
		ft bgs	%	mg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Cleanup Goal	**--**	**--**	**--**	**--**	**100**	**15,000**	**68,000**	**175,000**	**--**	**--**	**ND**	**ND**	**ND**	**ND**	**ND**	**--**	**--**
B4	6/26/95	6	--	<10	--	--	--	--	--	--	--	--	--	--	--	--	--
B4	6/26/95	7.5	--	<10	--	--	--	--	--	--	--	--	--	--	--	--	--
SB2296-1	**2/19/03**	**10**	**21.7**	**6.1J**	--	--	--	--	--	--	--	--	--	--	--	--	--
B4	6/26/95	12	--	1,000	<1	<1	<1	<1.3	--	--	--	--	--	--	--	--	--
B4	6/26/95	15	--	<10	--	--	--	--	--	--	--	--	--	--	--	--	--
B4	6/26/95	20	--	<10	--	--	--	--	--	--	--	--	--	--	--	--	--
B4	6/26/95	25	--	<10	--	--	--	--	--	--	--	--	--	--	--	--	--
RB1-027	2/26/97	8	--	<12	--	--	--	--	--	--	--	--	--	--	--	--	--
SB2296-2	**2/19/03**	**10**	**20.2**	**1,000**	**<130**	**<130**	**<130**	**<260**	**<630**	**<2,500**	**51**	**<1**	**<1**	**<1**	**<2**	**<5**	**<20**
RB1-029	2/26/97	12	--	315	<13	59	91	725	--	--	<0.5	<0.5	<0.5	<0.5	<1.5	--	--
BSW2296-1	11/17/00	12	20	2,200	3J	54J	6J	880J	--	--	--	--	--	--	--	--	--
RB1-030	2/26/97	17	--	<13	--	--	--	--	--	--	--	--	--	--	--	--	--
SB2296-3	**2/19/03**	**5**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB2-023	2/26/97	8	--	<12	--	--	--	--	--	--	--	--	--	--	--	--	--
RB2-025	2/26/97	12	--	1,100	<13	20	45	365	--	--	0.8	<0.5	<0.5	<0.5	<1.5	--	--
RB2-026	2/26/97	17	--	<13	--	--	--	--	--	--	--	--	--	--	--	--	--
BSW2296-2	11/17/00	12	20	3,200	<62	70	23J	1489J	--	--	--	--	--	--	--	--	--
SB2296-4	**2/19/03**	**10**	**21.1**	**640**	**<130**	**<130**	**<130**	**<260**	**<630**	**<2,500**	--	--	--	--	--	--	--
SB2296-5	**2/19/03**	**10**	**21.5**	**73**	**<1.3**	**<1.3**	**<1.3**	**<2.6**	**<6.4**	**<25**	--	--	--	--	--	--	--
B1	6/21/95	12	--	190	<0.1	<0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	--
B2	6/21/95	12	--	480	<0.5	<0.5	<0.5	<0.15	--	--	--	--	--	--	--	--	--
BSMP2296-2	11/3/00	12	22.5	268	<6.5	0.3J	0.5J	3J	--	--	--	--	--	--	--	--	--
BSW2296-3	11/3/00	12	22.8	568	<6.5	5J	0.4J	48J	--	--	--	--	--	--	--	--	--
B3	6/21/95	10	--	530	<0.1	<0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	--
SB2296-6	**2/19/03**	**10**	**21.5**	**53**	**<1.3**	**<1.3**	**<1.3**	**<2.6**	**<6.4**	**<25**	--	--	--	--	--	--	--
B3	6/21/95	12	--	360	<0.1	<0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	--
B3	6/21/95	15	--	31	<0.1	<0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	--
B3	6/21/95	20	--	<10	--	--	--	--	--	--	--	--	--	--	--	--	--

Bold = Recent soil confirmation sampling results

MTBE, Other = methyl tert-butyl ether, and other oxygenated compounds
TBA = tertiary butyl alcohol

Table 1-3

Average TPH-D Removal from Biosparging Site 2296
MCB Camp Pendleton

Sample	Sample Depth (ft bgs)	Groundwater Depth (ft bgs)	Height Above GW (ft)	Avg. Moisture (%)		Avg. TPH-D Conc. (mg/kg)		% TPH-D Reduction[a]
				Before System	After System	Before System	After System	
SB2296-1	10	10.5	0.5	NS	21.7	1,000	6.1	99%
SB2296-2	10	10.5	0.5	20	20.2	1,258	1,000	21%
SB2296-5	10	10.5	0.5	23	21.5	452	73	84%
SB2296-6	10	10.5	0.5	NS	21.5	445	53	88%
Site 2296	**10**	**11**	**0.5**	**22**	**21.2**	**685**	**354**	**48%**

ft bgs = feet below ground surface

GW = groundwater

NS = not sampled

[a]After two years of system operation from March 2001 through Feb. 2003

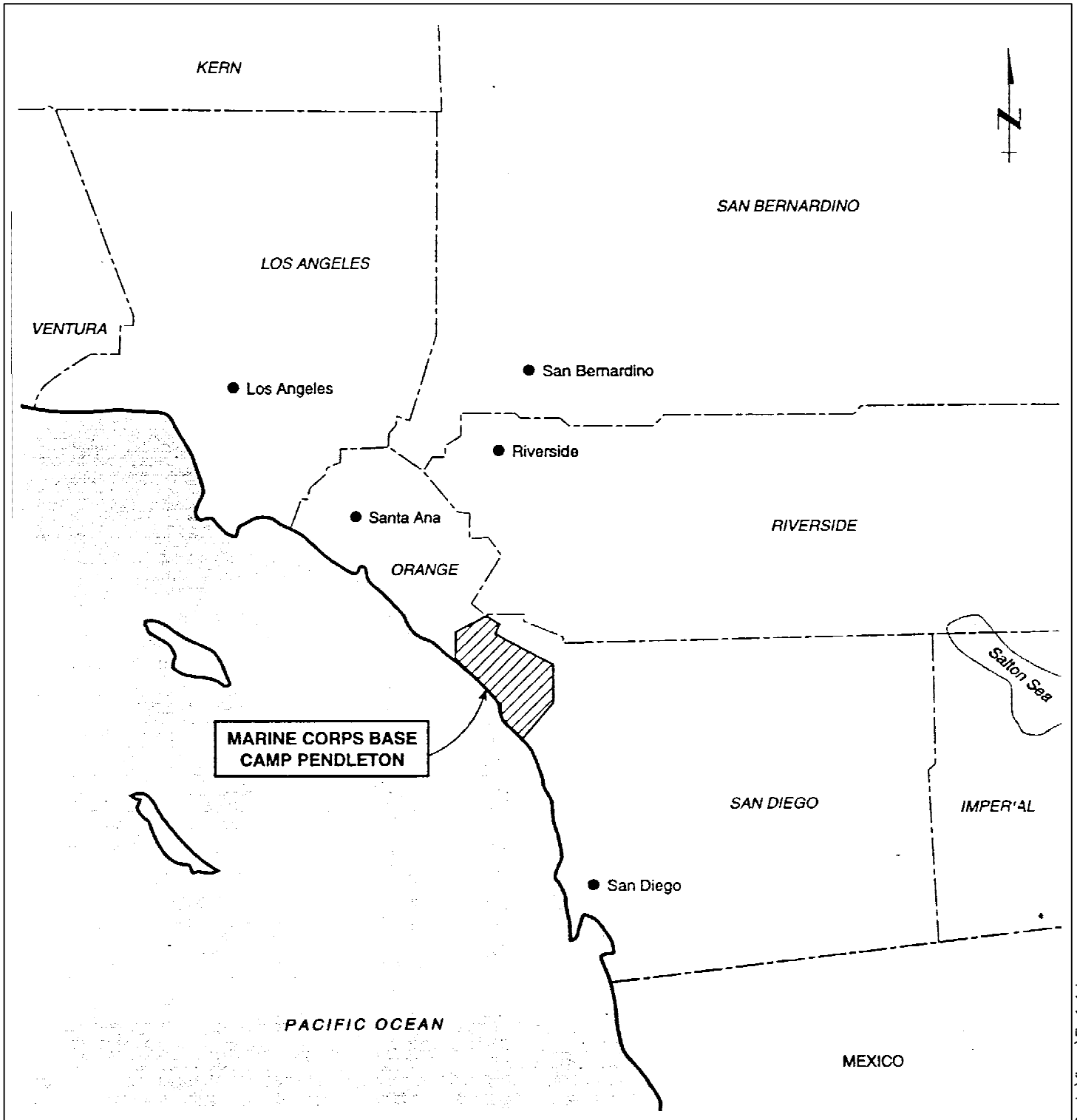

FIGURE 1-1

LOCATION OF MCB CAMP PENDLETON

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

Source:
USGS, California Index to Topograpic and Other Map Coverage Southern Callfornla, South Half (OHM, 1997).

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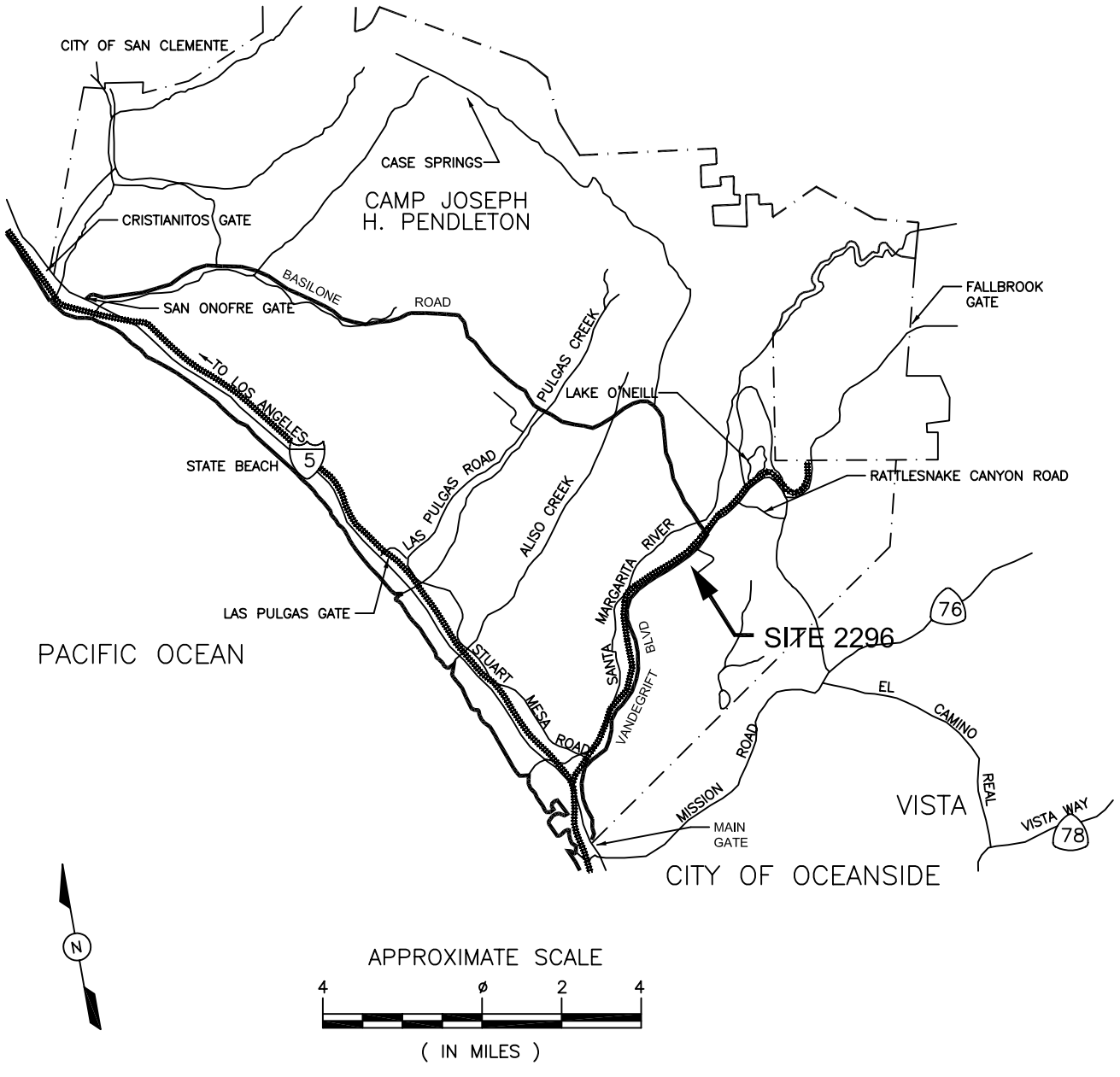

Roads & Highways
Creeks & Streams
MCB Camp Pendleton Boundary

Source: Metcalf & Eddy

FIGURE 1-2

SITE 2296 LOCATION

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

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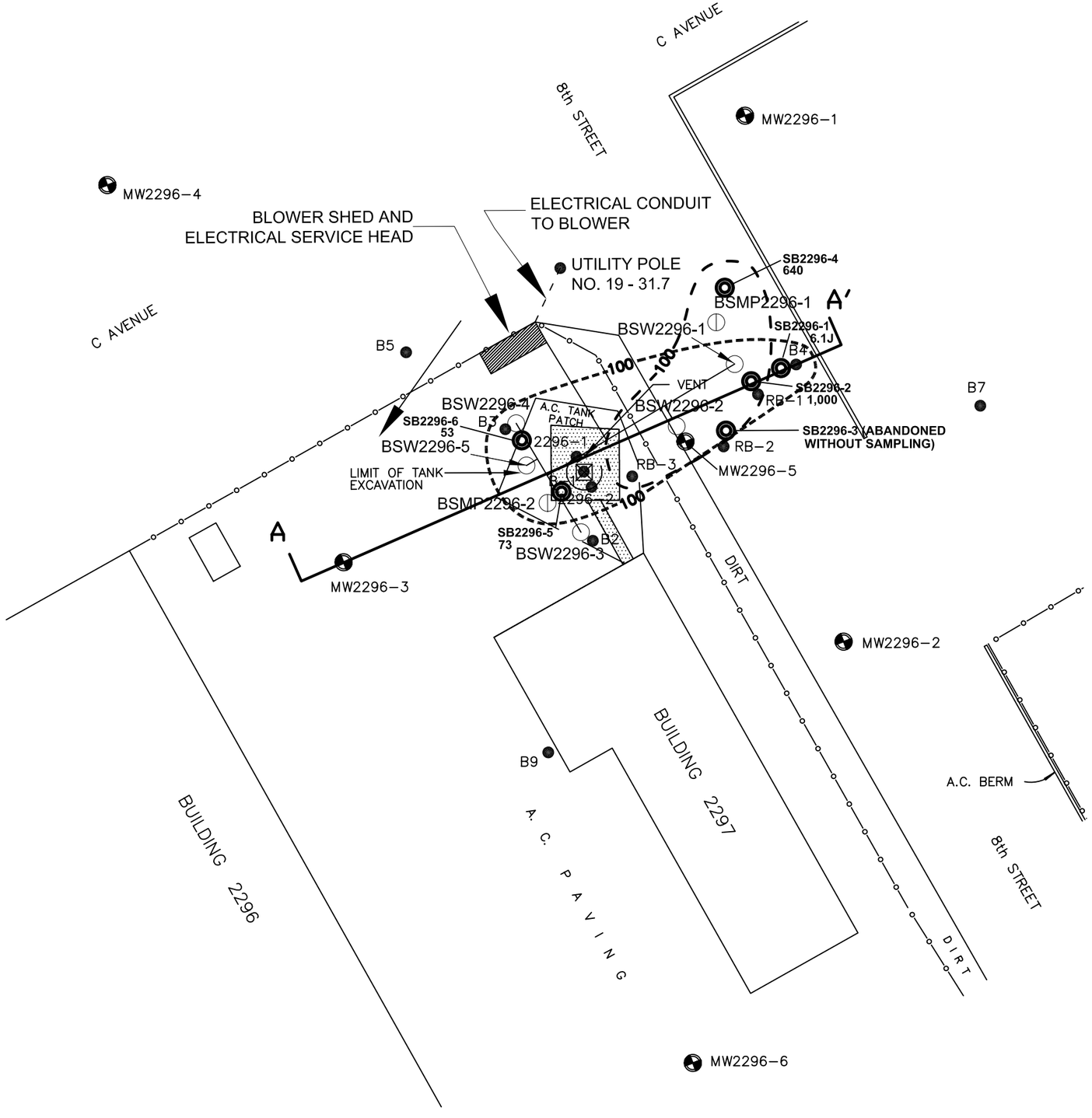

LEGEND

- FORMER BORING LOCATION
- MONITORING WELL
- FORMER UST LOCATION
- A.C. ASPHALTIC CONCRETE
- BIOSPARGING WELL (BSW)
- BIOSPARGING MONITORING POINT (BSMP)
- SB-1 640 FEBRUARY 2003 SOIL BORING LOCATION AND DETECTED SOIL TPH–D CONCENTRATION (mg/kg) AT 10 FT DEPTH
- BURIED PIPE NETWORK
- BURIED ELECTRICAL CONDUIT
- GROUNDWATER FLOW DIRECTION
- CROSS SECTION LINE
- FEBRUARY 2003 APPOXIMATE EXTENT OF SOIL CONTAMINATION TPH IN mg/kg
- OCT 1997, NOV 2000 APPROXIMATE EXTENT OF SOIL CONTAMINATION TPH IN mg/kg

N

20 0 20

(in feet)

FIGURE 1-3

DETAILED SITE LAYOUT

SITE 2296

MCB Camp Pendleton, California

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Pasadena, CA

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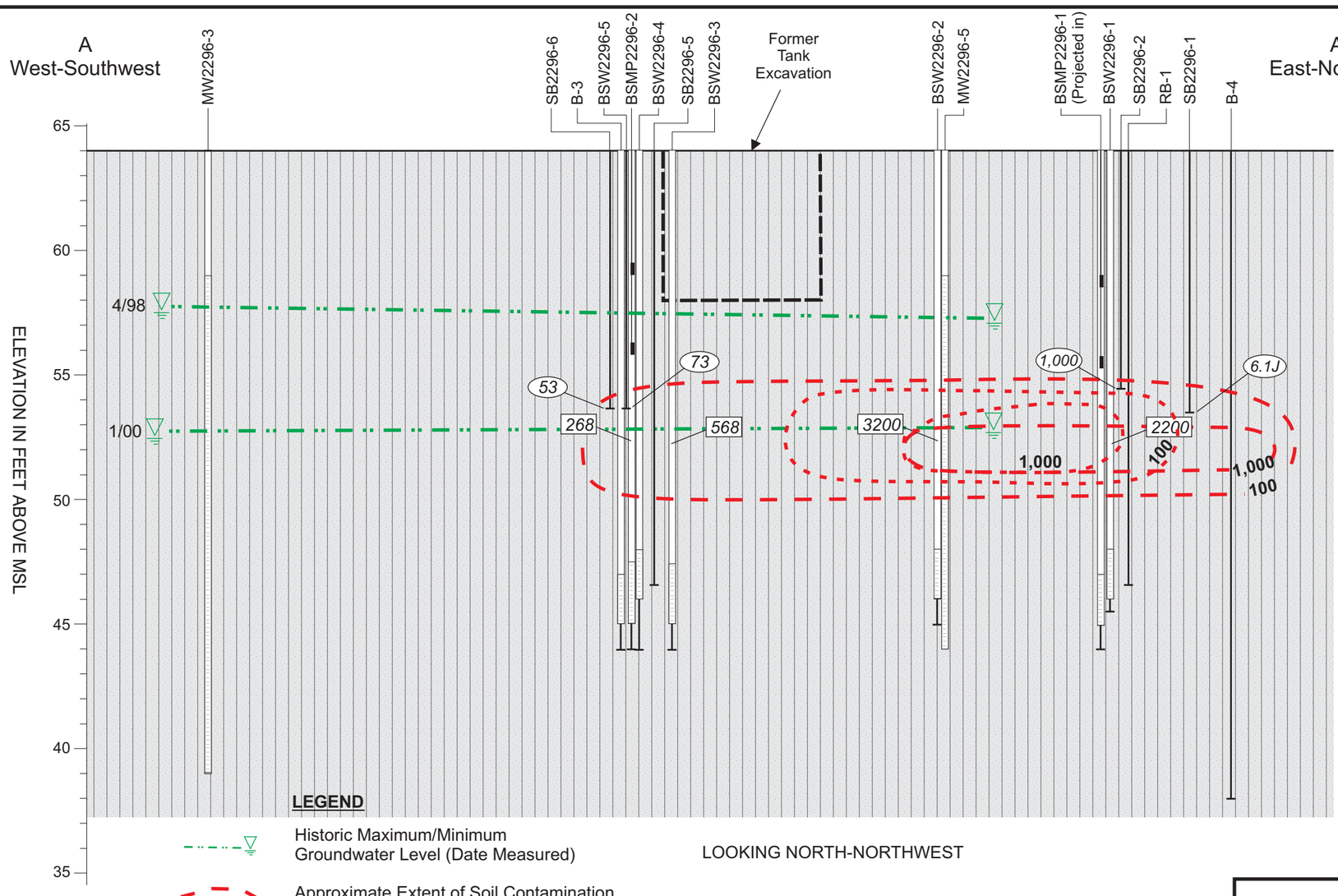

FIGURE 1-4

GEOLOGIC CROSS SECTION A-A' AND ESTIMATED EXTENT OF SOIL CONTAMINATION IN 2000

Site 2296
MCB Camp Pendleton, CA

PARSONS
Pasadena, CA

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SECTION 2

FIELD ACTIVITIES AND PROCEDURES

This section describes the field activities conducted during this monitoring event and the procedures used to conduct these activities. The activities described include (1) measurement of groundwater levels, (2) collection of groundwater samples for chemical analyses, (3) collecting quality assurance/quality control groundwater samples, (4) BS system operation and maintenance (O&M), and (5) measurement of soil gas concentrations for monitoring the BS performance within the vadose zone. Also included is a discussion on the management of investigation-derived waste.

2.1 GROUNDWATER LEVEL MEASUREMENTS

On April 14, 2005, prior to the collection of groundwater samples, groundwater levels were measured in six monitoring wells (MW2296-1 through MW2296-6) at the site.

The static depth to groundwater from the top of each well casing was measured to the nearest 0.01 foot using an electric water level probe. The depth to groundwater was converted to groundwater elevation using the surveyed top-of-casing elevation for each well.

2.2 GROUNDWATER PURGING AND SAMPLING

Five site monitoring wells (MW2296-1 through MW2296-3 and MW2296-5 and MW2296-6) were purged and sampled on April 15, 2005. MW2296-4 was not sampled, in accordance with the groundwater monitoring schedule contained in the *Remediation Verification Sampling Report* (Parsons, 2003). MW2296-1 also will no longer require sampling, in accordance with the annual monitoring schedule contained in the *Remediation Verification Sampling Report*.

Prior to the collection of a groundwater sample, each well was purged using a Grundfos® Redi-Flo II® pump with high density polyethylene (HDPE)-type tubing, set at a flow rate of approximately 2 gallons per minute (gpm) or less. For purging, the volume of water contained within the well casing at the time of purging was calculated, and at least three times the calculated volume was removed from the well. Water quality parameters (pH, temperature, specific conductivity, and turbidity) were measured at regular intervals using a direct-reading meter. Dissolved oxygen (DO) concentrations and the oxygen reduction potential (ORP) were measured using a YSI 6820 instrument with a flow-through cell. The well was considered sufficiently purged when consecutive measurements of pH, temperature, and specific conductivity varied by less than 10 percent, and a minimum of three well casing volumes were removed. If a monitoring well was evacuated to a dry state during purging, the monitoring well was allowed to recharge, and the sample was collected as soon as sufficient water was present in the monitoring well to obtain the necessary sample quantity.

For the collection of samples to be analyzed for nonvolatile compounds, the pump discharge was reduced to a minimal continuous flow, and the samples were collected directly into the appropriate sample containers. Samples to be analyzed for volatile

compounds were collected by lowering a new disposable polyethylene bailer into each well and carefully pouring the water down the inner walls of the sample bottle to minimize aeration of the sample.

In general, the groundwater samples were analyzed for the following specific compounds:

- TPH-D using U.S. Environmental Protection Agency (EPA) Method 8015 Modified;
- SVOC using EPA Method 8270C; and
- Geochemical parameters including sulfate and nitrate using EPA Method 300.0; ferrous iron (Fe(II)) using EPA Method 3500DFE; alkalinity using EPA Method 310.1; and methane using RSK175.

Types of containers and volumes collected are noted on the groundwater sampling data sheets (Appendix B).

2.3 QUALITY ASSURANCE AND QUALITY CONTROL

Groundwater samples were collected and preserved in accordance with both EPA and California Leaking Underground Fuel Tank (LUFT) protocols. The samples were delivered under a chain-of-custody in a cooler with ice to a state-certified laboratory.

Three types of quality-control (QC) samples were used to assess the adequacy of sampling, decontamination, and transportation procedures. Multiple sites are sampled during a given monitoring event; therefore, QC samples are collected appropriate to the defined need of the monitoring event, but not necessarily collected at every designated site.

- A trip blank sample was transported with each cooler and analyzed by Method 8260B. The trip blanks were used to determine whether cross-contamination of volatile organic compounds occurred during transportation to the laboratory.
- An equipment blank sample was collected during the monitoring event by running distilled water over the decontaminated pump. This sample was analyzed by Method 8015M to verify that the sampling equipment was free of organic contaminants.
- Field duplicate samples were collected at the rate of one for every ten primary samples and sent to the laboratory "blind."

2.4 BIOSPARGING SYSTEM OPERATION AND MAINTENANCE

BS system O&M was performed in accordance with the O&M Manual (Parsons, 2001b) and the *Remediation Verification Sampling Report* (Parsons, 2003). Based on field observation at BSMP-2 where elevated oxygen concentrations have been maintained, BSWs-3, -4, and -5 were closed on November 6, 2002 in order to maximize air injection to BSWs-1 and –2. In February 2003, the system was cycled off to allow for site equilibrium prior to verification sampling and the blower was disconnected and relocated to another site (Site 1131). In June 2003, a smaller blower (from Site 53435) was delivered to the site. In November 2003, the system was repaired and operation began with air injection into BSWs-1 and -2.

2.5 SOIL GAS SAMPLING

Soil gas sampling from selected monitoring wells began in March 2001 prior to startup of the BS system, and has been performed periodically as needed to evaluate the effect of BS on the vadose zone. Soil gas samples were collected in a Tedlar bag using a vacuum pump. Soil gas concentrations of oxygen (O_2) and carbon dioxide (CO_2) are measured using either a Gastech GT408 meter or a Landfill Gas Analyzer GA-90, which is able to measure CO_2 concentrations above 5%. Total volatile hydrocarbons (TVH) are periodically measured using a MiniRae photo-ionization detector (PID).

2.6 WASTE MANAGEMENT

During monitoring activities, groundwater was purged into a truck-mounted polyethylene tank and transported to Crosby and Overton for treatment and disposal under a nonhazardous-waste manifest. A copy of the manifest is presented in Appendix B.

SECTION 3

RESULTS

This section presents the results of field activities conducted at the site, including groundwater level measurements and laboratory analyses of groundwater samples collected during this monitoring event. All work was conducted in accordance with the Site 2296 Remediation Work Plan (Parsons, 2000a), the sampling plan updated in the installation and startup letter report (Parsons, 2001a), and the O&M Manual (Parsons, 2001b).

3.1 GROUNDWATER ELEVATIONS

Due to winter rains, groundwater levels increased in all wells measured this monitoring event in comparison to the last monitoring event. The wells showed an average increase of 2.71 feet, with a maximum increase of 3.2 feet in MW2296-4. Table 3-1 presents a summary of groundwater elevations measured since 1997. Historical groundwater elevations are provided in Appendix A. Figure 3-1 shows a hydrograph of the groundwater elevation data collected to date.

The hydraulic gradient calculated for this site was 0.003 southwest, which is consistent with previous events. The hydraulic gradient and flow direction are illustrated on Figure 3-2. In the last three years of groundwater monitoring, the flow direction has typically varied from southwest to west.

3.2 ANALYTICAL RESULTS

A summary of petroleum hydrocarbon concentrations detected in site groundwater since July 1998 is presented in Table 3-2. Historical data are provided in Appendix A.

3.2.1 Data Quality Assessment

Five primary samples were collected during this monitoring event and submitted to the laboratory for TPH-D analysis. One sample (MW2296-5) was also analyzed for SVOC. TPH-D was detected in the equipment blank EB-01-0405 (0.014 mg/L) and non-detect in the method blank resulting in the qualification as non-detect of TPH-D reported in MW2296-2 (0.033 mg/L). TPH-D and SVOC surrogate recoveries were acceptable for all site, method blank and QC samples. Laboratory control standard/laboratory control standard duplicate (LCS/LCSD) results indicate acceptable precision and accuracy of the SVOC and TPH-D methods. Based on the review of the laboratory reports and quality assurance (QA)/QC analyses, the data were deemed acceptable and usable as reported. TPH-D was SVOC target compounds were not detected in the method blank. Collected samples were properly preserved and shipped to the laboratory at a temperature of approximately 3 ^{o}C. Laboratory reports are provided in Appendix C.

3.2.2 Groundwater Contaminants

TPH-D was detected above the cleanup goal of 0.1 mg/L in one well, MW2296-5 (3.7 mg/L). This concentration is generally consistent with recent sampling events. The concentrations of TPH-D in MW2296-5 had steadily decreased since October 2002, until this sampling period in which the concentration increased slightly.

One of the wells (MW2296-5) was analyzed for the presence of SVOCs. None were detected.

Figure 3-3 shows the concentration trend of TPH-D detected in well MW2296-5 versus groundwater elevation over time. Figure 3-4 shows the locations and results of samples collected and analyzed during this monitoring event. Historical plume extents are shown on Figure A-1 in Appendix A.

3.2.3 Geochemical Indicators

Biodegradation causes measurable changes in groundwater chemistry. Specifically, concentrations of petroleum hydrocarbons, dissolved oxygen (DO), nitrate, Fe(II), sulfate, and methane in groundwater change both temporally and spatially as biodegradation proceeds. Petroleum hydrocarbons readily serve as electron donors in both aerobic and anaerobic biodegradation processes. Electron acceptors include (in order of decreasing preference) DO, nitrate, ferric iron (Fe[III]), sulfate, and CO_2. Electron acceptors and donors are depleted during biodegradation processes. Byproducts of biodegradation include CO_2, water, nitrogen gas, Fe(II), hydrogen sulfide, and methane. Alkalinity also increases as CO_2 is produced.

One purpose of biosparging is to inject oxygen to increase groundwater DO concentrations and hence facilitate removal of petroleum hydrocarbons. DO is utilized for aerobic degradation of dissolved-phase petroleum hydrocarbons, and is most effective when DO concentration are maintained above 2 mg/L (USEPA, 2004). DO data collected since startup of the BS is listed in Table 3-3. DO concentrations have been occasionally observed above 2 mg/L. In general, this indicates that the BS system has had some but limited effectiveness in oxygenating groundwater at the site.

Additional geochemical data collected during the April 2005 groundwater monitoring event are summarized in Table 3-4. The following geochemical evaluation is primarily based on the most recently collected data (April 2005) as representative of current conditions.

During groundwater purging, field measurements of DO ranged between 0.1 mg/L and 0.79 mg/L, which generally indicate that site groundwater is anaerobic.

ORP is a measure of the relative tendency of a solution to accept or transfer electrons. The ORP potential of a groundwater system depends on (and may in turn control) which electron acceptors are being reduced by microorganisms during BTEX oxidation. Low ORP measured in the areas of contamination provide a general indication that biodegradation is occurring. The ORP of groundwater measured in the field during

groundwater purging ranged from -28.7 millivolts (mV) to -110.2 mV, thus indicating strongly reducing conditions.

Nitrate concentrations at the site ranged from 1.4 mg/L to 6.7 mg/L. The lowest nitrate concentrations measured was in MW2296-5, the only well with a history of the presence of fuel hydrocarbon. This suggests that denitrification may have occurred or is occurring within the plume.

Sulfate concentrations measured in site samples ranged from 75 mg/L to 650 mg/L. The decreased sulfate concentration within the plume relative to background concentrations indicates that sulfate reduction may be occurring within the plume.

When Fe(III) is used as an electron acceptor during the anaerobic biodegradation of organic carbon, it is reduced to Fe(II), which is soluble in water. Higher Fe(II) concentrations inside the contaminant plume versus background Fe(II) concentrations can be used as an indicator that anaerobic degradation of organic carbon has occurred or is occurring via Fe(III) reduction. Fe(II) concentrations measured during this monitoring event ranged from non-detect (<0.05 mg/L) to 0.1 mg/L. The concentrations measured during this monitoring round are uniformly low and do not suggest that iron reduction is occurring.

Methane can be a strong indicator of biodegradation. The preferred biodegradation pathways discussed above produce acetate as an intermediate product and CO_2 as a final product of TPH-D and BTEX degradation. When oxygen and other electron acceptor levels are depleted, methanogenic bacteria begin to convert CO_2 to methane. Because methane is not present in fuel, the presence of methane above background concentrations in fuel-contaminated groundwater is indicative of microbial degradation of fuel hydrocarbons. Thus, an elevated methane concentration is an excellent indicator of microbial degradation. At Site 2296, detected methane concentrations ranged from 5.6 micrograms per liter (µg/L) to 2,000 µg/L, with the highest concentration corresponding to MW2296-5. The presence of elevated methane within the plume area strongly indicates that biodegradation of fuel hydrocarbons via methanogenesis is occurring.

In summary, the depletion of electron acceptors (nitrate and sulfate), elevated concentrations of metabolic byproducts (methane), and low redox potential within the plume strongly indicate groundwater conditions in which biodegradation of fuel hydrocarbons is occurring.

3.3 EXPLOSION HAZARD MONITORING

The well boxes, sewer manholes, and storm drain at the site were monitored for potential explosion hazards. On March 31, 2005, a lower explosive level (LEL) meter was used at the sewer manholes and the measurements were 0.0%. Therefore, there is no explosion hazard present at the site.

3.4 SOIL GAS DATA

Soil gas monitoring data collected from the vadose zone of the BSMPs are summarized in Table 3-5. Initially the O_2 concentration in BSMP-1 was depleted (<1%) and near depletion (6.9%) at BSMP-2. The O_2 concentrations have remained elevated

(near saturated oxygen conditions) during system operation. During respiration testing (once the BS system was turned off and during the off-cycle mode) oxygen levels at BSMP-1 slowly taper off to depletion. At BSMP-2, during the off period in April/May 2001, the oxygen concentration decreased to 15% after 12 days, but in March/April 2002 only to 17% after 2 months. In March 2005, after two weeks of respiration testing, oxygen concentrations at BSMP -1-5 and BSMP-1-8.5 remained elevated (greater than 19%). This suggested that little contamination remained in the subsurface soils in this area.

Oxygen utilization rates are determined from oxygen data obtained during in situ respiration testing. The rates are calculated as the zero order relationship between percent oxygen and time. Typically, a rapid linear decrease in oxygen is observed, followed by a lag period once oxygen concentrations drop below approximately 5% (Leeson et al., 1997). Figures 3-5 and 3-6 illustrate oxygen utilization versus time, as measured in selected BSMP-1-5 and BSMP-2-5.5, respectively, during respiration testing.

Oxygen utilization rates measured at Site 2296 have steadily decreased. The oxygen utilization rate measured in BSMP-1-5 was 0.64 %/day in April 2001, decreased to 0.30 %/day in 2002, to 0.04%/day in March/April 2004, and slightly increased to 0.11%/day in March 2005. The oxygen utilization rate measured in BSMP-2-5.5 was 0.31 %/day in 2001, and decreased to 0.03%/day by April/May 2002. Due to the decrease in BSMP-2-5.5, O_2 was not monitored during 2003-2004. Essentially, oxygen is no longer being utilized within the vadose zone at this site.

Table 3-1
Summary of Groundwater Elevation Data at Site 2296
MCB Camp Pendleton, California

Well	Date	Well Head Elevation (feet above MSL)	Depth to Water (feet)	Groundwater Elevation (feet above MSL)
MW-1	3/18/1997	63.63	6.40	57.23
MW-1	6/17/1997		7.79	55.84
MW-1	10/27/1997		10.68	52.95
MW-1	2/4/1998		9.06	54.57
MW-1	4/6/1998		6.43	57.20
MW-1	7/20/1998		7.16	56.47
MW-1	10/21/1998		8.55	55.08
MW-1	1/25/1999		7.52	56.11
MW-1	5/13/1999		7.31	56.32
MW-1	7/19/1999		8.27	55.36
MW-1	10/4/1999		9.52	54.11
MW-1	1/25/2000		10.62	53.01
MW-1	4/3/2000		8.95	54.68
MW-1	7/23/2000		9.42	54.21
MW-1	10/15/2000		10.37	53.26
MW-1	2/7/2001		9.06	54.57
MW-1	4/27/2001		7.06	56.57
MW-1	10/10/2001		9.20	55.02
MW-1	4/24/2002		7.75	55.88
MW-1	10/15/2002		10.45	53.18
MW-1	10/10/2003		7.91	55.72
MW-1	3/29/2004		6.45	57.18
MW-1	10/21/2004		8.52	55.11
MW-1	**4/14/2005**		**5.65**	**57.98**
MW-2	3/18/1997	64.22	7.12	57.10
MW-2	6/17/1997		8.72	55.50
MW-2	10/28/1997		11.46	52.76
MW-2	2/4/1998		9.32	54.9
MW-2	4/6/1998		6.98	57.24
MW-2	7/20/1998		8.05	56.17
MW-2	10/21/1998		9.55	54.67
MW-2	1/25/1999		8.12	56.10
MW-2	5/13/1999		7.96	56.26
MW-2	7/19/1999		9.08	55.14
MW-2	10/4/1999		10.42	53.80
MW-2	1/25/2000		11.11	53.11
MW-2	4/3/2000		9.28	54.94
MW-2	7/23/2000		9.89	54.33
MW-2	10/15/2000		11.17	53.05
MW-2	2/7/2001		9.30	54.92
MW-2	4/27/2001		7.61	56.61
MW-2	10/10/2001		10.32	53.70
MW-2	4/24/2002		8.49	55.73
MW-2	10/15/2002		11.21	53.01
MW-2	10/10/2003		8.75	55.47
MW-2	3/29/2004		7.30	56.92
MW-2	10/21/2004		9.23	54.99
MW-2	**4/14/2005**		**6.62**	**57.60**

Table 3-1
Summary of Groundwater Elevation Data at Site 2296
MCB Camp Pendleton, California

Well	Date	Well Head Elevation (feet above MSL)	Depth to Water (feet)	Groundwater Elevation (feet above MSL)
MW-3	3/19/1997	64.02	6.95	57.07
MW-3	6/18/1997		8.36	55.66
MW-3	10/27/1997		11.21	52.81
MW-3	2/4/1998		9.65	54.37
MW-3	4/6/1998		7.01	57.01
MW-3	7/20/1998		7.76	56.26
MW-3	10/21/1998		9.23	54.79
MW-3	1/25/1999		8.21	55.81
MW-3	5/13/1999		7.91	56.11
MW-3	7/19/1999		8.95	55.07
MW-3	10/4/1999		10.20	53.82
MW-3	1/25/2000		11.25	52.77
MW-3	4/3/2000		9.58	54.44
MW-3	7/23/2000		10.91	53.11
MW-3	10/15/2000		11.04	52.98
MW-3	2/7/2001		9.73	54.29
MW-3	4/27/2001		7.74	56.28
MW-3	10/10/2001		9.90	54.12
MW-3	4/24/2002		8.45	55.57
MW-3	10/15/2002		11.07	52.95
MW-3	10/10/2003		8.55	55.47
MW-3	3/29/2004		7.03	56.99
MW-3	10/21/2004		9.22	54.80
MW-3	**4/14/2005**		**6.27**	**57.75**
MW-4	10/27/1997	63.84	10.78	53.06
MW-4	2/4/1998		9.49	54.35
MW-4	4/6/1998		6.77	57.07
MW-4	7/20/1998		7.45	56.39
MW-4	10/21/1998		8.83	55.01
MW-4	1/25/1999		NM	NM
MW-4	5/13/1999		NM	NM
MW-4	7/19/1999		NM	NM
MW-4	10/4/1999		NM	NM
MW-4	1/25/2000		NM	NM
MW-4	4/3/2000		NM	NM
MW-4	7/23/2000		NM	NM
MW-4	10/15/2000		NM	NM
MW-4	2/7/2001		NM	NM
MW-4	4/27/2001		NM	NM
MW-4	10/10/2001		NM	NM
MW-4	4/24/2002		8.63	55.21
MW-4	10/15/2002		11.11	52.73
MW-4	10/10/2003		8.55	55.29
MW-4	3/29/2004		7.12	56.72
MW-4	10/21/2004		9.37	54.47
MW-4	**4/14/2005**		**6.17**	**57.67**

Table 3-1
Summary of Groundwater Elevation Data at Site 2296
MCB Camp Pendleton, California

Well	Date	Well Head Elevation (feet above MSL)	Depth to Water (feet)	Groundwater Elevation (feet above MSL)
MW-5	10/27/1997	64.10	11.18	52.92
MW-5	2/4/1998		9.28	54.82
MW-5	4/6/1998		6.84	57.26
MW-5	7/20/1998		7.80	56.30
MW-5	10/21/1998		9.25	54.85
MW-5	1/25/1999		8.00	56.10
MW-5	5/13/1999		7.82	56.28
MW-5	7/19/1999		8.85	55.25
MW-5	10/4/1999		10.19	53.91
MW-5	1/25/2000		11.07	53.03
MW-5	4/3/2000		9.34	54.76
MW-5	7/23/2000		9.69	54.41
MW-5	10/15/2000		11.00	53.10
MW-5	2/7/2001		9.41	54.69
MW-5	4/27/2001		7.55	56.55
MW-5	10/10/2001		9.86	54.24
MW-5	4/24/2002		8.34	55.76
MW-5	10/15/2002		11.04	53.06
MW-5	10/10/2003		8.57	55.53
MW-5	3/29/2004		7.09	57.01
MW-5	10/21/2004		8.47	55.63
MW-5	**4/14/2005**		**6.35**	**57.75**
MW-6	10/27/1997	64.07	11.37	52.7
MW-6	2/4/1998		9.13	54.94
MW-6	4/6/1998		6.83	57.24
MW-6	7/20/1998		8.05	56.02
MW-6	10/21/1998		9.60	54.47
MW-6	1/25/1999		8.17	55.90
MW-6	5/13/1999		8.01	56.06
MW-6	7/19/1999		9.22	54.85
MW-6	10/4/1999		10.51	53.56
MW-6	1/25/2000		11.17	52.90
MW-6	4/3/2000		9.28	54.79
MW-6	7/23/2000		10.18	53.89
MW-6	10/15/2000		11.26	52.81
MW-6	2/7/2001		9.30	54.77
MW-6	4/27/2001		7.65	56.42
MW-6	10/10/2001		10.15	53.92
MW-6	4/24/2002		8.48	55.59
MW-6	10/15/2002		11.24	52.83
MW-6	10/10/2003		8.84	55.23
MW-6	3/29/2004		7.32	56.75
MW-6	10/21/2004		9.18	54.89
MW-6	**4/14/2005**		**6.65**	**57.42**

MSL Mean sea level
ND Not detected
NM Not measured (well paved over)
Bold indicates results from the most recent sampling event.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 2296
MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
MW-1	2296-MW1-600	7/20/1998	< 0.1	< 0.5	< 0.2	0.07 J1	< 0.4	NA
MW-1	MW 2296-1	10/22/1998	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-1	MW2296-1-0199	1/27/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-1	MW2296-1-0599	5/13/1999	< 0.5	< 0.5	< 0.6	< 0.74	< 1.6	NA
MW-1	MW2296-1-1099	10/4/1999	< 0.1	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-1	MW2296-1-1000	10/16/2000	< 0.5	NA	NA	NA	NA	NA
MW-1	MW2296-1-1001	10/10/2001	< 0.1	NA	NA	NA	NA	NA
MW-1	MW2296-1	4/24/2002	< 0.096	NA	NA	NA	NA	NA
MW-1	MW2296-1-1002	10/16/2002	< 0.096	NA	NA	NA	NA	NA
MW-1	MW2296-1-1003	10/10/2003	0.026 J1	NA	NA	NA	NA	NA
MW-1	MW2296-1-0304	3/29/2004	0.079	NA	NA	NA	NA	NA
MW-1	MW2296-1-1004	10/21/2004	0.043 J1	NA	NA	NA	NA	NA
MW-1	MW2296-1-0405	4/15/2005	< 0.096	NA	NA	NA	NA	NA

Estimated Value
Result is less than the PQL but greater than the MDL
L Project quantitation limit
L Method detection limit

mg/L milligram per liter
µg/L microgram per liter
NA not analyzed
NS not sampled

MTBE methyl tert-butyl ether
EB Equipment blank
TB Trip blank
d Field duplicate sample

Sample analyzed using method SW8260B instead of method SW8021

TEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
PH-D groundwater cleanup goals correspond to drinking water secondary MCLs.

tes: All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling even and in MW2296-4 during October 2001. All results were non-detect.
Sample MW2296-4-10-01 collected and analyzed by Navy Public Works Center. Well had been paved over with asphalt.
BTEX sampling of all wells discontinued per remediation work plan.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 2296
MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
MW-2	2296-MW2-601	7/20/1998	< 0.03	< 0.5	< 0.09	< 0.5	< 1.5	NA
MW-2	MW 2296-2	10/22/1998	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-2	MW2296-2-0199	1/26/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-2	MW2296-2-0599	5/13/1999	< 0.5	< 0.5	< 0.6	< 0.74	< 1.6	NA
MW-2	MW2296-2-1099	10/4/1999	< 0.02	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-2	MW2296-2-0400	4/4/2000	0.05 J1	NA	NA	NA	NA	NA
MW-2	MW2296-2-1000 *	10/17/2000	< 0.06	< 1 *	< 1 *	< 1 *	< 2 *	< 5 *
MW-2	MW2296-2-0401	5/1/2001	0.04 J1	NA	NA	NA	NA	NA
MW-2	MW2296-2-1001	10/10/2001	< 0.1	NA	NA	NA	NA	NA
MW-2	MW2296-2	4/25/2002	< 0.096	NA	NA	NA	NA	NA
MW-2	MW2296-2-1002	10/16/2002	< 0.07	NA	NA	NA	NA	NA
MW-2	MW2296-2-1003	10/10/2003	0.051 J1	NA	NA	NA	NA	NA
MW-2	MW2296-2-0304	3/29/2004	0.053	NA	NA	NA	NA	NA
MW-2	MW2296-2-1004	10/21/2004	0.18	NA	NA	NA	NA	NA
MW-2	MW2296-2-0405	4/15/2005	< 0.033	NA	NA	NA	NA	NA

J Estimated Value
J1 Result is less than the PQL but greater than the MDL
PQL Project quantitation limit
MDL Method detection limit

mg/L milligram per liter
µg/L microgram per liter
NA not analyzed
NS not sampled

MTBE methyl tert-butyl ether
EB Equipment blank
TB Trip blank
d Field duplicate sample

* Sample analyzed using method SW8260B instead of method SW8021

[1] BTEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs). TPH-D groundwater cleanup goals correspond to drinking water secondary MCLs.

Notes: All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling even and in MW2296-4 during October 2001. All results were non-detect.
Sample MW2296-4-10-01 collected and analyzed by Navy Public Works Center. Well had been paved over with asphalt.
BTEX sampling of all wells discontinued per remediation work plan.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 2296
MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
MW-3	2296-MW3-602	7/20/1998	< 0.1	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-3	MW 2296-3	10/22/1998	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-3	MW2296-3-0199	1/27/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-3	MW2296-3-0599	5/13/1999	0.08 J1	< 0.5	< 0.6	< 0.74	< 1.6	NA
MW-3	MW2296-3-0799	7/21/1999	0.1 J1	< 0.5	< 0.5	< 0.5	< 0.74	< 5
MW-3 d	MW2296-99-0799	7/21/1999	0.1 J1	< 0.5	< 0.5	< 0.5	< 0.74	< 5
MW-3	MW2296-3-1099	10/4/1999	< 0.06	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-3	MW2296-3-0100	1/26/2000	0.1 J1	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-3	MW2296-3-0400	4/4/2000	0.1 J1	NA	NA	NA	NA	NA
MW-3	MW2296-3-0700	7/24/2000	< 0.2	NA	NA	NA	NA	NA
MW-3	MW2296-3-1000 *	10/17/2000	< 0.2	< 1 *	< 1 *	< 1 *	< 2 *	< 5 *
MW-3	2296-3-0201	2/8/2001	0.2 J1	NA	NA	NA	NA	NA
MW-3	MW2296-3-0401	5/1/2001	0.2	NA	NA	NA	NA	NA
MW-3	MW2296-3-1001	10/10/2001	0.2	NA	NA	NA	NA	NA
MW-3	MW2296-3	4/25/2002	0.2	NA	NA	NA	NA	NA
MW-3	MW2296-3-1002	10/16/2002	< 0.009	NA	NA	NA	NA	NA
MW-3	MW2296-3-1003	10/10/2003	0.14	NA	NA	NA	NA	NA
MW-3	MW2296-3-0304	3/29/2004	0.12	NA	NA	NA	NA	NA
MW-3	MW2296-3-1004	10/21/2004	0.092 J1	NA	NA	NA	NA	NA
MW-3	MW2296-3-0405	4/15/2005	0.075 J1	NA	NA	NA	NA	NA
MW-4	2296-MW4-603	7/20/1998	< 0.5	< 0.5	< 0.09	< 0.5	< 0.5	NA
MW-4	MW 2296-4	10/22/1998	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-4	MW2296-4-10-01 *	10/2/2001	< 0.145	< 0.5 *	< 0.5 *	< 0.5 *	< 1.5 *	< 1 *
MW-4	MW2296-4	4/26/2002	< 0.02	NA	NA	NA	NA	NA
MW-4	MW2296-4-1002	10/16/2002	< 0.02	NA	NA	NA	NA	NA

J Estimated Value
J1 Result is less than the PQL but greater than the MDL
PQL Project quantitation limit
MDL Method detection limit

mg/L milligram per liter
µg/L microgram per liter
NA not analyzed
NS not sampled

MTBE methyl tert-butyl ether
EB Equipment blank
TB Trip blank
d Field duplicate sample

* Sample analyzed using method SW8260B instead of method SW8021

[1] BTEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs). TPH-D groundwater cleanup goals correspond to drinking water secondary MCLs.

Notes: All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling even and in MW2296-4 during October 2001. All results were non-detect.
Sample MW2296-4-10-01 collected and analyzed by Navy Public Works Center. Well had been paved over with asphalt.
BTEX sampling of all wells discontinued per remediation work plan.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 2296
MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
MW-5	2296-MW5-604	7/20/1998	2.9	0.4 J1	< 0.5	1.1	< 0.4	NA
MW-5	MW 2296-5	10/22/1998	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	NA
MW-5	MW2296-5-0199	1/28/1999	2.9	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-5 d	MW7-2296-0199	1/28/1999	3.1	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-5	MW2296-5-0599	5/13/1999	2.3	1	< 0.6	< 0.74	< 1.6	NA
MW-5 d	MW2296-99-0599	5/13/1999	2.5	< 0.5	< 0.6	< 0.74	< 1.6	NA
MW-5	MW2296-5-1099	10/4/1999	2.45	< 0.5	< 0.5	1	< 1.5	NA
MW-5 d	MW2296-99-1099	10/4/1999	2.47	< 0.5	< 0.5	1	< 1.5	NA
MW-5	MW2296-5-0400	4/4/2000	2.5	NA	NA	NA	NA	NA
MW-5	MW2296-5-1000 *	10/17/2000	2.8	0.3 J1 *	< 1 *	< 1 *	< 2 *	< 5 *
MW-5	MW2296-5-0401	5/1/2001	2.14	NA	NA	NA	NA	NA
MW-5	MW2296-5-1001 *	10/10/2001	2.52	< 1 *	< 1 *	< 1 *	< 2 *	< 5 *
MW-5	MW2296-5	4/26/2002	3.89	NA	NA	NA	NA	NA
MW-5	MW2296-5-1002	10/16/2002	5.78	NA	NA	NA	NA	NA
MW-5	MW2296-5-1003	10/13/2003	5	NA	NA	NA	NA	NA
MW-5 d	MW2296-99-1003	10/13/2003	3.2	NA	NA	NA	NA	NA
MW-5	MW2296-5-0304	3/29/2004	3.8	NA	NA	NA	NA	NA
MW-5 d	MW2296-99-0304	3/29/2004	4	NA	NA	NA	NA	NA
MW-5	MW2296-5-1004	10/21/2004	3.4 J	NA	NA	NA	NA	NA
MW-5 d	MW2296-99-1004	10/21/2004	1.9 J	NA	NA	NA	NA	NA
MW-5	MW2296-5-0405	4/15/2005	3.7	NA	NA	NA	NA	NA

J Estimated Value
J1 Result is less than the PQL but greater than the MDL
PQL Project quantitation limit
MDL Method detection limit

mg/L milligram per liter
µg/L microgram per liter
NA not analyzed
NS not sampled

MTBE methyl tert-butyl ether
EB Equipment blank
TB Trip blank
d Field duplicate sample

Sample analyzed using method SW8260B instead of method SW8021

BTEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
TPH-D groundwater cleanup goals correspond to drinking water secondary MCLs.

Notes: All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling even and in MW2296-4 during October 2001. All results were non-detect.
Sample MW2296-4-10-01 collected and analyzed by Navy Public Works Center. Well had been paved over with asphalt.
BTEX sampling of all wells discontinued per remediation work plan.

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MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
lean Up Goals [1]			0.1	1	150	680	1750	13
IW-6	2296-MW6-605	7/20/1998	< 0.5	< 0.5	< 0.09	< 0.5	< 1.5	NA
IW-6	MW 2296-6	10/23/1998	1.6 J	< 0.5	< 0.5	< 0.5	< 1.5	NA
IW-6	MW2296-6-0199	1/27/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	< 5
IW-6	MW2296-6-0599	5/13/1999	< 0.5	< 0.5	< 0.6	< 0.74	< 1.6	NA
IW-6	MW2296-6-0799	7/21/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 0.74	< 5
IW-6	MW2296-6-1099	10/4/1999	< 0.1	< 0.5	< 0.5	< 0.5	< 1.5	NA
IW-6	MW2296-6-0100	1/26/2000	0.1 J1	< 0.5	< 0.5	< 0.5	< 1.5	NA
IW-6	MW2296-6-0400	4/4/2000	0.05 J1	NA	NA	NA	NA	NA
IW-6	MW2296-6-0700	7/24/2000	< 0.5	NA	NA	NA	NA	NA
IW-6	MW2296-6-1000 *	10/17/2000	< 0.05	< 1 *	< 1 *	< 1 *	< 2 *	< 5 *
IW-6	2296-6-0201	2/8/2001	0.05 J1	NA	NA	NA	NA	NA
IW-6	MW2296-6-0401	5/1/2001	< 0.1	NA	NA	NA	NA	NA
IW-6	MW2296-6-1001	10/10/2001	< 0.08	NA	NA	NA	NA	NA
IW-6	MW2296-6	4/25/2002	< 0.096	NA	NA	NA	NA	NA
IW-6	MW2296-6-1002	10/16/2002	< 0.096	NA	NA	NA	NA	NA
IW-6	MW2296-6-1003	10/13/2003	0.028	NA	NA	NA	NA	NA
IW-6	MW2296-6-0304	3/29/2004	0.033	NA	NA	NA	NA	NA
IW-6	MW2296-6-1004	10/21/2004	0.033 J1	NA	NA	NA	NA	NA
IW-6	MW2296-6-0405	4/15/2005	< 0.096	NA	NA	NA	NA	NA

Estimated Value
Result is less than the PQL but greater than the MDL
L Project quantitation limit
IL Method detection limit

mg/L milligram per liter
µg/L microgram per liter
NA not analyzed
NS not sampled

MTBE methyl tert-butyl ether
EB Equipment blank
TB Trip blank
d Field duplicate sample

Sample analyzed using method SW8260B instead of method SW8021

TEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
PH-D groundwater cleanup goals correspond to drinking water secondary MCLs.

tes: All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling even and in MW2296-4 during October 2001. All results were non-detect.
Sample MW2296-4-10-01 collected and analyzed by Navy Public Works Center. Well had been paved over with asphalt.
BTEX sampling of all wells discontinued per remediation work plan.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 2296
MCB Camp Pendleton, California

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lean Up Goals [1]			0.1	1	150	680	1750	13
EB	EB-04-0599	5/13/1999	< 0.5	< 0.5	< 0.6	< 0.74	< 1.6	NA
EB	EB-01-0799	7/20/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	4 J1
EB	EB-01-1099	10/6/1999	0.02 J1	< 0.5	< 0.5	< 0.5	< 1.5	< 5
EB	EB-01-0100	1/27/2000	NA	< 0.5	< 0.5	< 0.5	< 1.5	NA
EB	EB-01-0400	4/11/2000	< 0.5	< 0.5	< 0.5	< 0.5	< 2	NA
EB	EB01-0700	7/25/2000	0.08 J1	< 0.5	< 0.5	< 0.5	< 1.5	NA
EB	EB-01-1000	10/16/2000	< 0.5	NA	NA	NA	NA	NA
EB	EB-02-1000 *	10/17/2000	0.08 J1	< 1 *	< 1 *	< 1 *	< 2 *	< 5 *
EB	EB-01-0201	2/8/2001	< 0.5	< 0.5	< 0.5	< 0.5	0.9	< 5
EB	EB06-0401 *	5/1/2001	< 0.1	< 1 *	< 1 *	< 1 *	< 2 *	< 5 *
EB	EB-01-1001 *	10/10/2001	0.04 J1	< 1 *	< 1 *	< 1 *	< 2 *	< 5 *
EB	QCEB	4/25/2002	< 0.096	0.3 J1	0.5 J1	0.8	0.9 J1	NA
EB	QCEB	4/26/2002	< 0.096	< 0.5	0.4 J1	0.9	1	NA
EB	QCEB01-1002	10/16/2002	0.2	NA	NA	NA	NA	NA
EB	EB-01-1003	10/16/2003	< 0.096	0.11 J1	0.46 J1	< 0.5	1.9	NA
EB	EB-01-0404	4/1/2004	< 0.096	0.2 J1	0.65	< 0.5	1.5	< 5 *
EB	EB-01-0405 *	4/11/2005	0.014 J1	< 1	0.69 J1	1	< 3.7	NA
TB	TB-04-0599	5/13/1999	NA	< 0.5	< 0.6	< 0.74	< 1.6	NA
TB	TRIP BLANK	7/21/1999	NA	< 0.5	< 0.5	< 0.5	< 0.74	< 5
TB	TB-01-1099	10/4/1999	NA	< 0.5	< 0.5	< 0.5	< 1.5	NA
TB	TRIP BLANK	1/26/2000	NA	< 0.5	< 0.5	< 0.5	< 1.5	NA
TB	TB-01-1000 *	10/17/2000	NA	< 1 *	< 1 *	< 1 *	< 2 *	< 5 *
TB	TB-01-1001 *	10/10/2001	NA	< 1 *	< 1 *	< 1 *	< 2 *	< 5 *
TB	QCTB	4/25/2002	NA	< 0.5	0.3 J1	< 0.5	0.8 J1	NA
TB	QCTB	4/26/2002	NA	< 0.5	0.4 J1	0.8	1.3	NA

Estimated Value
Result is less than the PQL but greater than the MDL
- Project quantitation limit
L Method detection limit

mg/L milligram per liter
µg/L microgram per liter
NA not analyzed
NS not sampled

MTBE methyl tert-butyl ether
EB Equipment blank
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d Field duplicate sample

Sample analyzed using method SW8260B instead of method SW8021

TEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
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es: All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling even and in MW2296-4 during October 2001. All results were non-detect.
Sample MW2296-4-10-01 collected and analyzed by Navy Public Works Center. Well had been paved over with asphalt.
BTEX sampling of all wells discontinued per remediation work plan.

Table 3-3
Recent Dissolved Oxygen Data for Site 2296
MCB Camp Pendleton, California

Monitoring Location	BSMP-1-19 7.5 ft from BSW-1		BSMP-2-19 7 ft from BSW-3&5		MW-1 40 ft from BSW-1		MW-3 33 ft from BSW-5		MW-5 4 ft from BSW-2	
DATE	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)
Baseline monitoring										
03/28/01	0914	2.47	0854	0.09	0831	0.13	0837	0.12	0816	0.19
System startup: 03/28/01 10:37										
03/28/01	1047	1.89	1059	0.09	1050	0.14	-	-	1054	0.11
03/28/01	1106	4.04	1116	0.07	-	-	1121	0.09	1112	0.11
03/28/01	1127	2.62	1139	0.08	1131	0.08	-	-	1135	0.34
03/28/01	1201	3.75	1216	0.08	1208	0.10	1221	0.09	1211	0.77
03/28/01	1245	5.49	1301	0.09	1251	0.10	-	-	1255	2.12
03/28/01	1347	4.41	1404	0.08	1357	0.08	1411	0.08	1403	3.13
03/29/01	1151	5.01	1123	0.12	1139	0.10	1121	0.16	1137	6.32
03/30/01	0752	4.53	0738	0.11	0754	0.11	0740	0.17	0749	6.56
04/02/01	1159	3.34	1142	0.10	1154	0.09	1136	0.14	1147	7.47
04/06/01	0940	2.34	0901	0.09	0932	2.00	0851	0.19	0923	7.57
04/11/01	1208	2.60	1313	0.09	1231	0.09	1257	0.15	1235	7.39
04/20/01	0816	0.70	0752	0.05	0802	0.06	0743	0.10	0807	7.75
System shut-off/respiration testing: 04/20/01 09:12										
04/20/01	1016	1.07	1014	0.09	1017	0.10	1013	0.08	1015	7.31
04/20/01	1442	0.83	1501	0.08	1457	0.13	-	-	1455	3.43
04/23/01	1334	0.05	1412	0.06	1327	0.06	1418	0.06	1359	0.13
05/02/01	1018	0.09	1105	0.06	-	-	1053	0.07	1033	0.08
07/13/01	1130	0.08	-	-	1130	0.13	1115	0.26	1125	0.13
System restarted: 07/13/01										
09/24/01	1130	0.18	1040	0.16	1115	0.43	1102	0.17	1121	0.15
System shutdown prior to groundwater sampling event: 9/24/01 11:50										
10/10/01	-	-	-	-	951	0.96	1438	0.38	1151	0.49
System shutdown prior to groundwater sampling event: 03/28/02 10:00										
04/25/02	-	-	-	-	1524	0.31	1341	0.04	1253	0.22
System cycled off: 06/07/02										
07/02/02	1223	4.86	1245	2.00	-	-	-	-	-	-
07/11/02	0939	0.55	0915	0.34	-	-	-	-	-	-
System cycled on: 07/11/02 10:00										
System shut off: 09/06/02 16:30										
09/17/02	1045	1.81	-	-	-	-	-	-	-	-
10/16/02	0930	3.75	-	-	1113	0.74	902	8.7	1139	0.7
10/25/02	0831	1.12	-	-	-	-	-	-	-	-
10/31/02	1255	0.6	-	-	-	-	-	-	-	-
System cycled on with wells BSW-1 and -2: 11/06/02 11:00										
02/10/03	1300	0.55	1322	0.48	-	-	-	-	1308	9.43
System cycled off: 02/10/03 14:20										
02/14/03	0954	0.83	1015	0.24	-	-	-	-	1001	3.06
10/10/03	-	-	-	-	1207	0.01	1410	0.05	746	0.13
System cycled on with smaller blower in BSW-1 and -2: 11/25/03 21:30										
02/16/03	-	6.35	-	-	-	-	-	-	-	7.8
03/19/04	-	8.25	-	-	-	-	-	-	-	6.9
System cycled off 3/19/04 at 0	-	-	-	-	-	-	-	-	-	-
03/22/04	-	6.8	-	-	-	-	-	-	-	1.18
03/26/04	-	-	-	-	1049	0.27	1241	0.22	1340	1.1

Table 3-3
Recent Dissolved Oxygen Data for Site 2296
MCB Camp Pendleton, California

System cycled on with smaller blower in BSW-1 and -2: 04/16/04 0730										
System cycled off 9/21/04 at 1310										
09/21/04	-	0.38	-	-	-	-	-	-	-	0.23
09/22/04	-	0.48	-	-	-	-	-	-	-	0.39
10/02/04	-	0.25	-	-	-	-	-	-	-	0.19
10/21/04	-	-	-	-	1427	0.78	1447	0.88	1522	0.74
System cycled on 11/10/04										
02/02/05	-	4.96	-	-	-	-	-	-	-	0.75
System off: 03/17/05										
03/22/05	1045	5.34	-	-	-	-	-	-	1045	0
03/31/05	0935	1.08	-	-	-	-	-	-	0935	2.06

DO = dissolved oxygen
mg/L = milligrams per liter

Table 3-4
Summary of Groundwater Geochemical Data at Site 2296
MCB Camp Pendleton, California

Well	Date	DO (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)	Fe (II) (mg/L)	CH4 (µg/L)	ORP (mV)	CO2 (ppm)	Alkalinity (mg/L)
MW1	3/19/1997	NA	<0.2	544	NA	109	NA	NA	1920
MW1	6/20/1997	NA	<2	610	NA	144	NA	NA	1990
MW1	10/27/1997	3.7	<1.6	495	ND	141	30	NA	1980
MW1	2/4/1998	1.4	<2	500	ND	180	78	NA	1950
MW1	4/6/1998	2.68	<3.2	630	NA	43.8	136	NA	1910
MW1	7/20/1998	1.8	7 J1	490	0.01	57	95.6	90	2080
MW1	10/22/1998	0.28	<16	670	0	74	119.6	>100	1460
MW1	1/27/1999	8.22	<20	750	0.0	21	81.1	65	1600
MW1	**4/15/2005**	**0.31[1]**	**3.6 J1**	**300**	**0.1**	**17**	**-49.1[1]**	**NA**	**1800**
MW2	3/19/1997	NA	<0.04	162	NA	10	NA	NA	635
MW2	6/20/1997	NA	0.44	176	NA	20.9	NA	NA	728
MW2	10/27/1997	1.9	<0.4	147	ND	33	80	NA	799
MW2	2/4/1998	1.82	0.37	16	ND	<3	67	NA	209
MW2	4/6/1998	NA	<0.4	172	ND	11.2	127	NA	659
MW2	7/20/1998	6.26	5	120	0.13	15	20.9	30	660
MW2	10/22/1998	0.2	<2	170	0	23	130.4	45	740
MW2	1/27/1999	1.25	<4	190	0.04	12	71.2	24	720
MW2	**4/15/2005**	**0.1[1]**	**2.2**	**75**	**< 0.05**	**13**	**- 33.3[1]**	**NA**	**300**
MW3	3/19/1997	NA	<0.2	600	NA	407	NA	NA	1310
MW3	6/18/1997	NA	<2	646	NA	540	NA	NA	1320
MW3	10/27/1997	3.5	<2	589	ND	284	60	NA	1230
MW3	2/4/1998	0.62	<2	582	ND	630	67	NA	1270
MW3	4/6/1998	0.56	<3.2	700	0.01	3.83	126	NA	1270
MW3	7/20/1998	0.33	<10	610	0	320	92.4	70	1480
MW3	10/22/1998	0.04	<8	730	0.09	210	144.7	38	1260
MW3	1/27/1999	1.66	<20	1200	0.07	140	93.3	65	1600
MW3	**4/15/2005**	**0.13[1]**	**6.7 J1**	**650**	**< 0.05**	**100**	**- 28.7[1]**	**NA**	**1500**
MW4	10/27/1997	5.9	<1.6	380	ND	8.2	50	NA	1530
MW4	2/4/1998	3.96	<1.6	455	ND	1100	85	NA	1580
MW4	4/6/1998	3.86	<0.5	183	ND	43.5	161	NA	1630
MW4	7/20/1998	2.75	<8	430	0	9.4	91.5	45	1640
MW4	10/22/1998	0.13	<8	460	0.01	580	149.3	60	1560
MW4	1/27/1999	NS	NS	NS	NS	NS	NS	NS	NS
MW5	10/27/1997	4.7	<0.5	183	ND	2 J	70	NA	1420
MW5	2/4/1998	1.97	<0.16	35	0.5	2200	52	NA	970
MW5	4/6/1998	2.2	0.19	22.3	ND	1330	-5	NA	724
MW5	7/20/1998	3.6	<5	50 J1	1.37	2200	11.1	60	1000
MW5	10/23/1998	0.2	<16	100J	0.18	1700	41.1	50	600
MW5	1/28/1999	1.46	<4	50	0.0	<3	49.4	36	880
MW5	**4/15/2005**	**0.79[1]**	**1.4 J1**	**150**	**< 0.05**	**2000**	**- 110.2[1]**	**NA**	**600**
MW6	10/27/1997	1.95	0.63	153	ND	21	80	NA	706
MW6	2/4/1998	6.68	<1.6	170	0.8	61	43	NA	710
MW6	4/6/1998	0.38	<0.5	153	0.4	42.1	58	NA	724
MW6	7/20/1998	0.15	3	84	0.1	2500	98.2	33	760
MW6	10/22/1998	0.21	2J	120	0.04	15	163	23	1180
MW6	1/27/1999	1.74	<4	90	0.03	7.4	97.5	30	800
MW6	**4/15/2005**	**0.1[1]**	**4.7**	**95**	**0.086**	**5.6**	**- 61.7[1]**	**NA**	**580**

)O Dissolved Oxygen
Fe (II) Ferrous iron
CH4 Methane
ORP Oxidation-reduction potential
CO2 Carbon dioxide
J Estimated value
J1 Result is less than the CRDL but greater than the MDL
Bold indicates results from the most recent sampling event.
Field measurement obtained during purging

ppm Parts per million by volume
mg/L milligrams per liter
µg/L micrograms per liter
mV millivolts
NS Not sampled (well is paved over)
CRDL contract required detection limit
MDL method detection limit

LS, Geochem

8/2/2005

Table 3-5
Biosparging Soil Gas Data for Site 2296
MCB Camp Pendleton, California

Monitoring Location	BSMP-1-5 Distance to BSW-1: 7.5 ft				BSMP-1-8.5 Distance to BSW-1: 7.5 ft				BSMP-2-5.5 Distance to BSW-3&5: 7 ft			
DATE	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)
Baseline Monitoring												
03/28/01	0947	<1	8.3	732.7	-	-	-	-	1010	6.9	3.9	133.5
System Startup: 03/28/01 10:37												
03/28/01	1238	6.4	5.7	205.7	-	-	-	-	1227	6.0	4.4	49.8
03/29/01	1210	<1	12.1	420.4	-	-	-	-	1119	10.5	5.0	199.8
03/30/01	0815	10.6	3.6	95.1	-	-	-	-	0745	18.1	0.1	5.5
04/02/01	1208	5.5	5.2	400.1	-	-	-	-	1225	16.8	2.6	63.2
04/06/01	0955	13.3	5.2	152.6	-	-	-	-	0847	17.4	2.6	2.8
04/11/01	1209	18.4	2.2	90.8	-	-	-	-	1311	18.4	2.4	-
04/20/01	0827	18.6	2.6	50.6	-	-	-	-	0902	19.0	2.1	6.4
System Shut-Off/Respiration Testing: 04/20/01 09:12												
04/20/01	1014	18.9	2.6	104	-	-	-	-	1011	19.3	1.4	29.6
04/20/01	1440	18.4	3.8	47.6	-	-	-	-	1453	18.2	2.4	12.4
04/23/01	1349	17.4	2.5	42.7	-	-	-	-	1430	18.0	1.7	57.2
05/02/01	1027	11.1	3.8	36.7	-	-	-	-	1115	15.1	2.2	17.8
07/13/01	1155	<1	>5	11.1	-	-	-	-	-	-	-	-
System Restarted: 07/13/01												
09/24/01	1139	19.1	2.4	140	-	-	-	-	1049	20.2	0.8	80
System Shutdown Prior to Groundwater Sampling Event: 9/24/01 11:50												
System Restarted: 10/31/01 10:55												
System Cycled Off: 02/15/02 12:59												
02/26/02	0911	20.9	0.1	19.2	-	-	-	-	0928	20.9	0.4	34.5
System Restarted: 02/26/02 09:35												
System Cycled Off: 03/8/02 07:02												
System Restarted: 03/19/02 16:18												
System Shutdown Prior to Groundwater Sampling Event: 03/28/02 10:00												
03/28/02	1015	20.7	0.4	0.0	-	-	-	-	Covered by truck			
04/04/02	1042	20.0	0.6	0.0	-	-	-	-	1048	20.2	0.6	0.0
04/22/02	1343	13.8	2.7	-	-	-	-	-	1343	19.5	4.8	-
05/02/02	1026	8.8	3.45	-	-	-	-	-	Covered by truck			
05/22/02	0838	7	0.9	0.0	-	-	-	-	0840	18.9	0.65	0.4
05/30/02	1050	<1	1.5	0.0	-	-	-	-	1055	17.2	0.6	0.0

Table 3-5
Biosparging Soil Gas Data for Site 2296
MCB Camp Pendleton, California

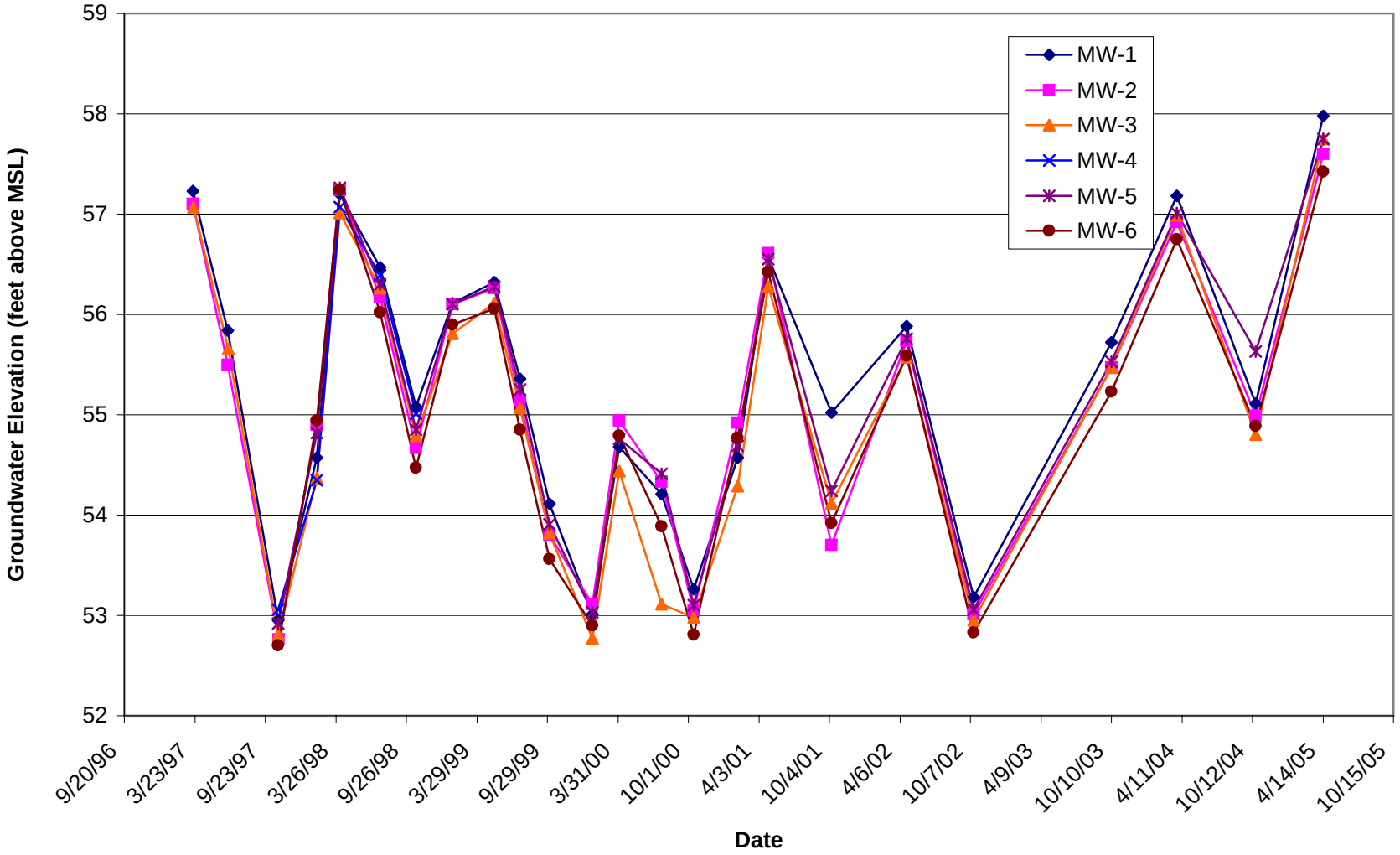
Monitoring Location	BSMP-1-5 Distance to BSW-1: 7.5 ft				BSMP-1-8.5 Distance to BSW-1: 7.5 ft				BSMP-2-5.5 Distance to BSW-3&5: 7 ft			
DATE	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)
System Restarted: 05/30/02 11:00												
06/24/02	1148	16.5	0.8	1.0	-	-	-	-	1150	20.6	0	0.0
System cycled off: 06/07/02												
07/02/02	1223	11.5	1.6	0.0	-	-	-	-	1248	17.4	0.4	0.0
07/11/02	0950	5.5	2.2	0.0	-	-	-	-	0930	16.3	0.7	0.0
System cycled on: 07/11/02 10:00												
System cycled off: 07/26/02 0817												
07/26/02	08:30	18.3	1.6	0.0	-	-	-	-	-	-	-	-
08/02/02	1125	15.0	2.6	-	1127	2.6	0.8	-	-	-	-	-
System cycled on: 08/02/02 11:30												
08/16/02	0910	18.9	1.55	-	-	-	-	-	-	-	-	-
System cycled off: 08/16/02 09:15												
System cycled on: 08/22/02 07:10												
System cycled off: 08/29/02 11:25												
09/17/02	1045	15.9	1.8	-	-	-	-	-	-	-	-	-
09/27/02	1048	14.3	1.6	-	-	-	-	-	-	-	-	-
10/15/02	0930	8.8	1.35	-	-	-	-	-	-	-	-	-
10/25/02	0831	5.2	0.6	-	-	-	-	-	-	-	-	-
10/31/02	1255	2.6	1.4	-	-	-	-	-	-	-	-	-
System cycled on: 11/06/02 11:00, with wells BSW-1 and -2												
02/10/03	1304	21.1	0.0	0.6	1306	0.0	0.3	5.6	1325	19.3	0.5	0.5
System Cycled Off: 02/10/03 14:20												
02/14/03	956	20.8	0.0	0.6	1023	3.0	0.3	5.2	1022	19.1	0.5	0.0
02/17/03	1158	20.2	0.0	0.4	1189	5.3	0.3	8.4	Covered by truck			
Soil Confirmation Sampling: 2/19/03												
System cycled on with smaller blower in BSW-1 and -2: 11/25/03 21:30												
System cycled off 3/19/04 at 0800												
03/26/04	-	20.4	0	-	-	-	-	-	-	-	-	-
04/16/04	-	19.5	0	-	-	-	-	-	-	-	-	-
System cycled on with smaller blower in BSW-1 and -2: 04/16/04 0730												
System cycled off 09/21/04												
System cycled on with smaller blower in BSW-1 and -2: 11/10/04												
System off: 03/17/05												

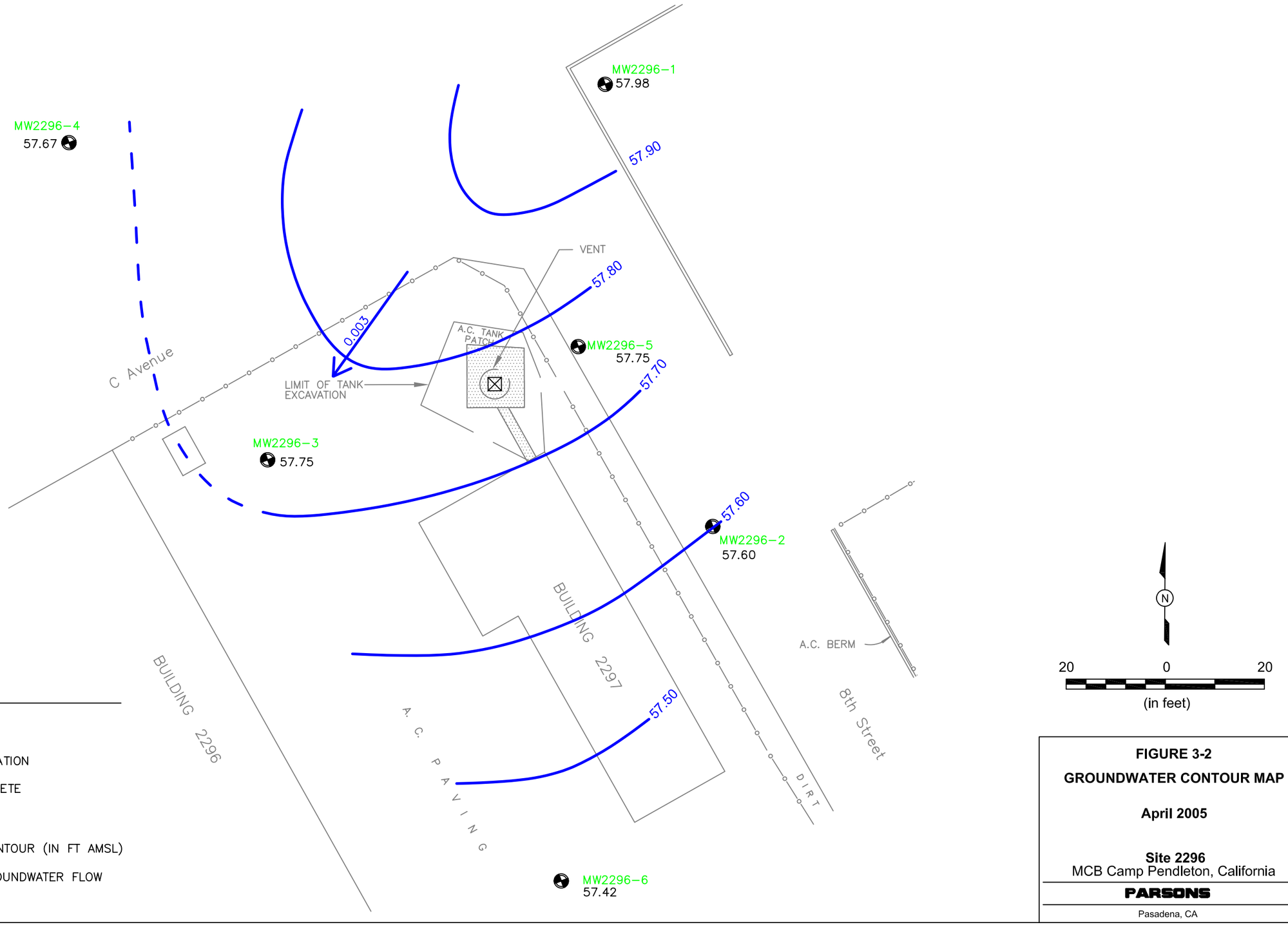
Table 3-5
Biosparging Soil Gas Data for Site 2296
MCB Camp Pendleton, California

Monitoring Location	BSMP-1-5 Distance to BSW-1: 7.5 ft				BSMP-1-8.5 Distance to BSW-1: 7.5 ft				BSMP-2-5.5 Distance to BSW-3&5: 7 ft			
DATE	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)
03/22/05	1045	20.5	0.5	-	-	-	-	-	-	-	-	-
03/31/05	935	19.5	0.3	11.2	935	20.2	0.2	8.9	-	-	-	-

ft = feet
% = percent
ppmv = parts per million by volume
in H2O = inches of water
O_2 = oxygen
CO_2 = carbon dioxide
TVH = total volatile hydrocarbons
Press = pressure

Figure 3-1
Site 2296 Hydrograph





LEGEND

MW2296–4	⊕	MONITORING WELL
	⊠	FORMER UST LOCATION
A.C.		ASPHALTIC CONCRETE
NA		NOT MEASURED
57.50		GROUNDWATER CONTOUR (IN FT AMSL)
	→	DIRECTION OF GROUNDWATER FLOW

FIGURE 3-2

GROUNDWATER CONTOUR MAP

April 2005

Site 2296
MCB Camp Pendleton, California

PARSONS

Pasadena, CA

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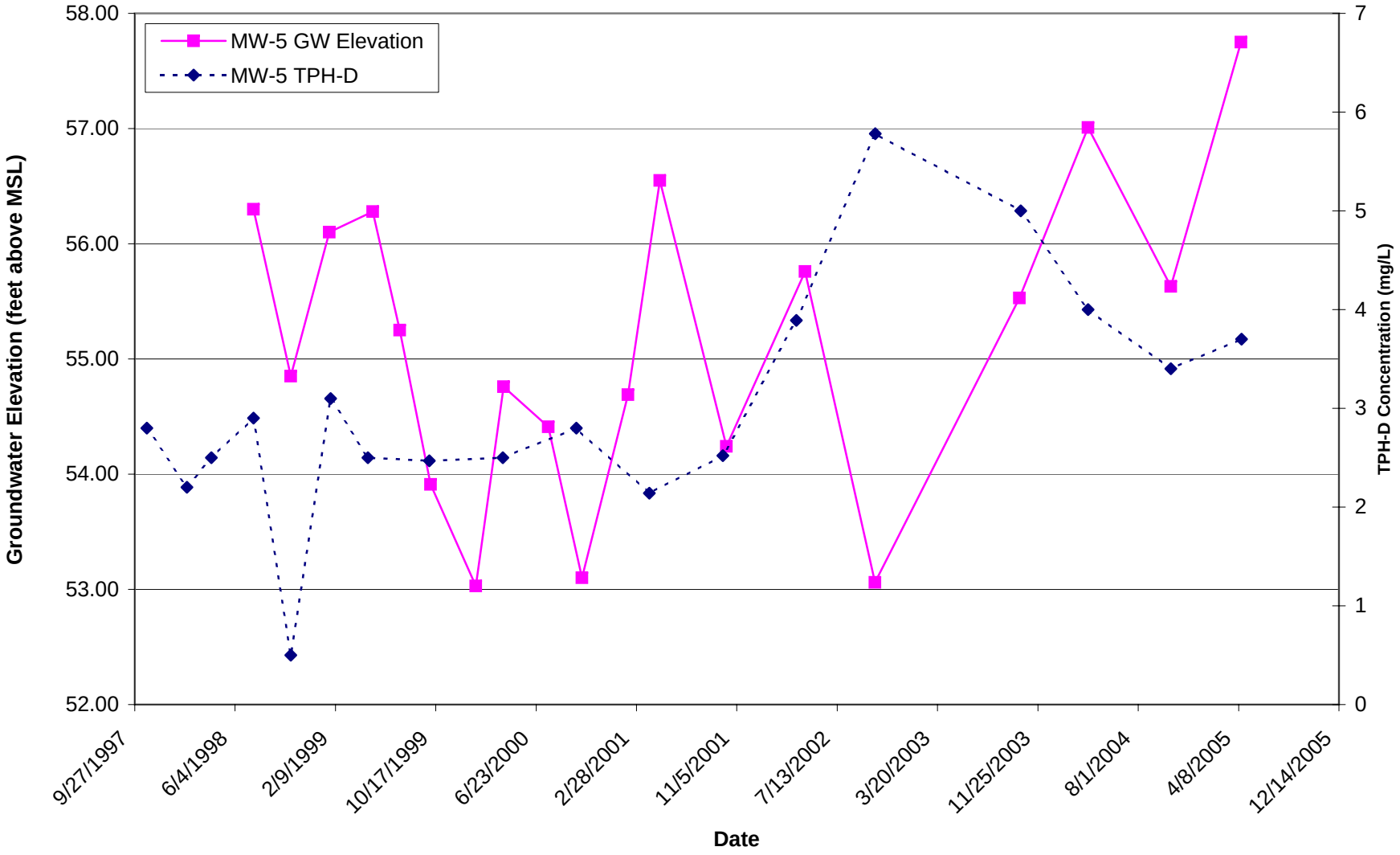
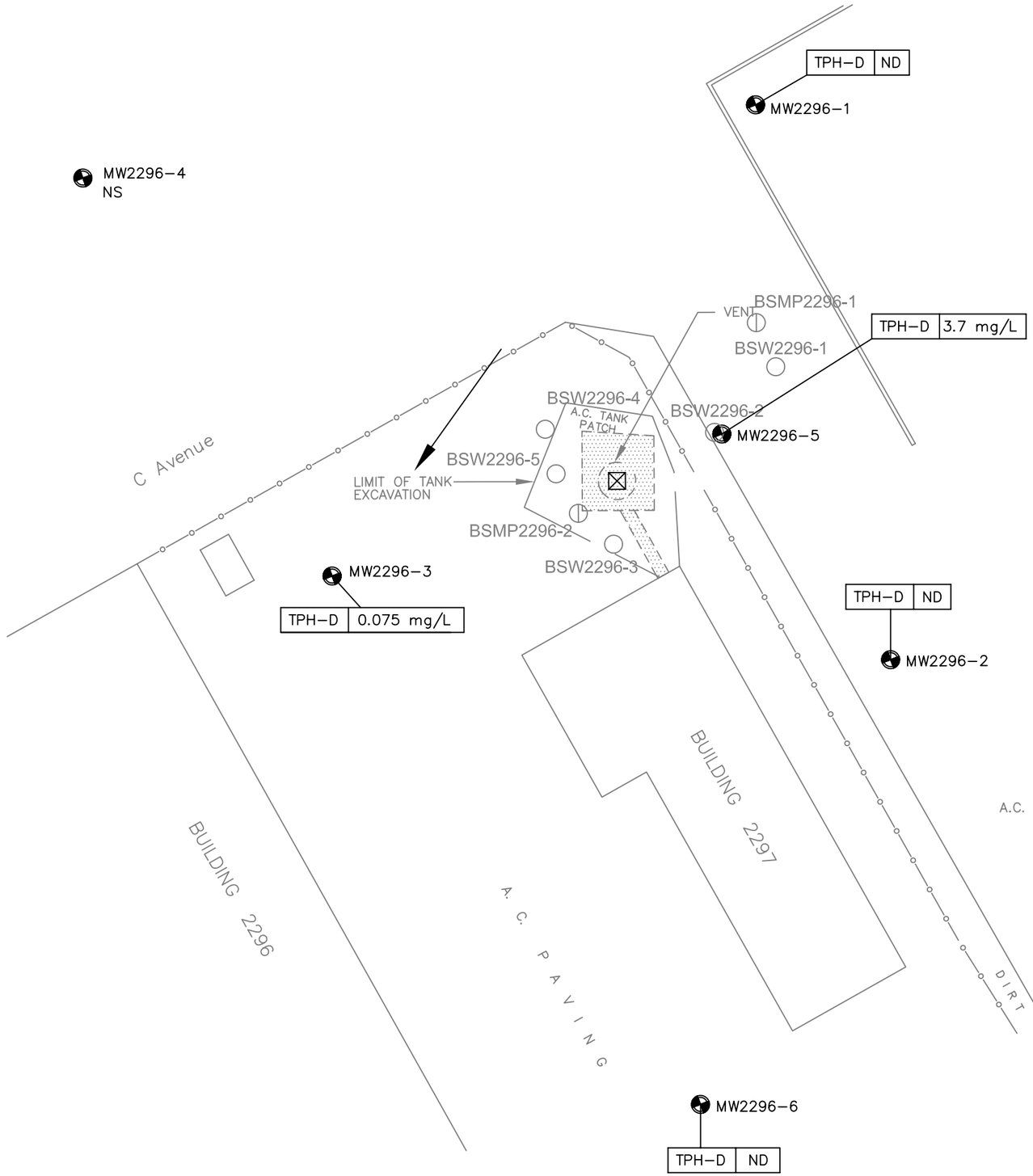
Figure 3-3
TPH-D Concentration versus Groundwater Elevation at MW-5 at Site 2296





LEGEND

MWH49–1	MONITORING WELL
	FORMER UST LOCATION
BSW2296–1	BIOSPARGING WELL
BSMP2296–1	BIOSPARGING MONITORING POINT
TPH–D	TOTAL PETROLEUM HYDROCARBONS AS DIESEL
J1	DETECTED CONCENTRATION IS BELOW THE REPORTING LIMIT BUT ABOVE THE METHOD DETECTION LIMIT
ND	NOT DETECTED
NS	NOT SAMPLED
mg/L	MILLIGRAMS PER LITER
	GROUNDWATER FLOW DIRECTION

N

20 0 20

(in feet)

FIGURE 3-4

DISTRIBUTION OF GROUNDWATER CONTAMINANTS

April 2005

Site 2296

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

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Figure 3-5
Oxygen Utilization at Site 2296 BSMP-1-5

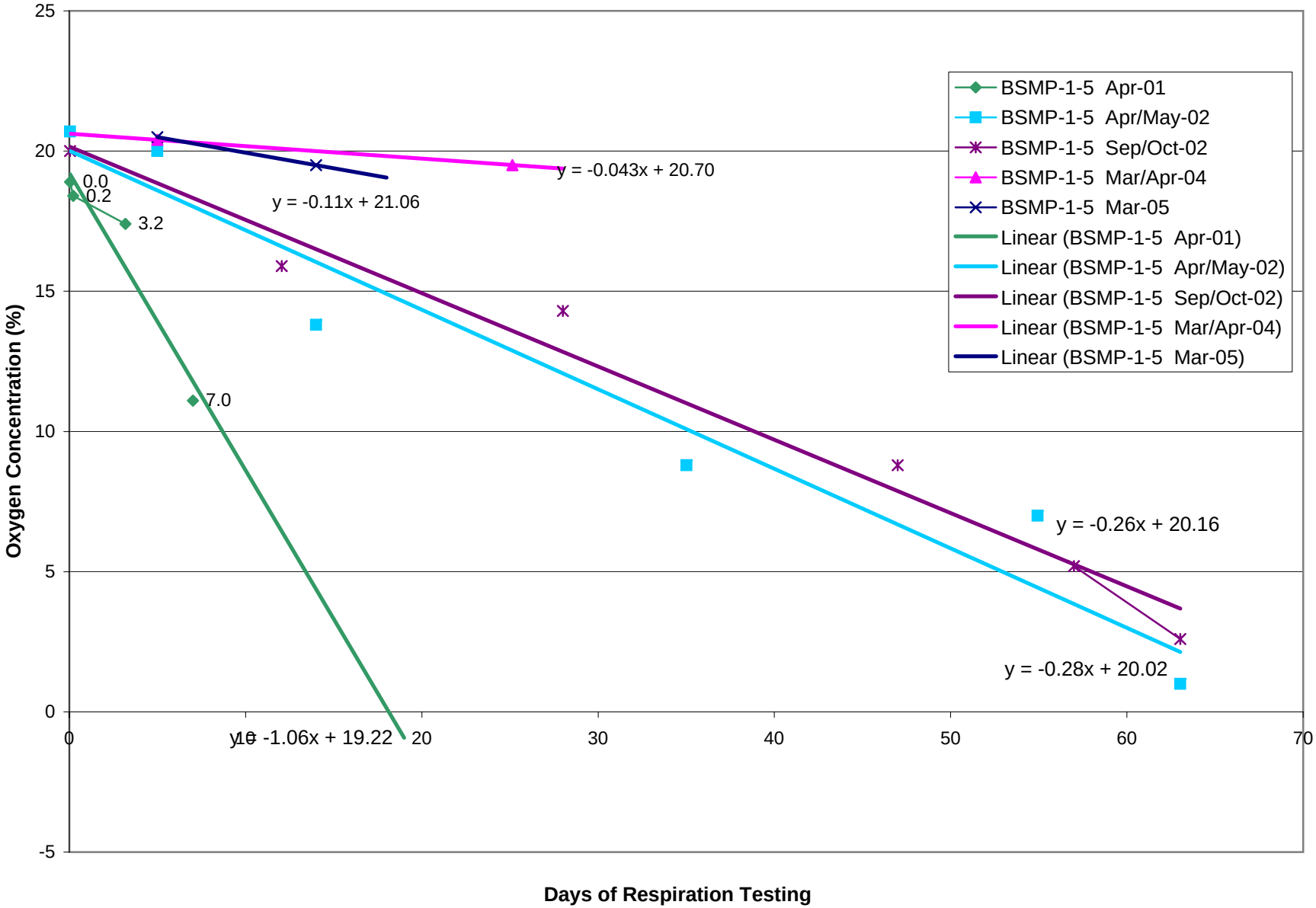
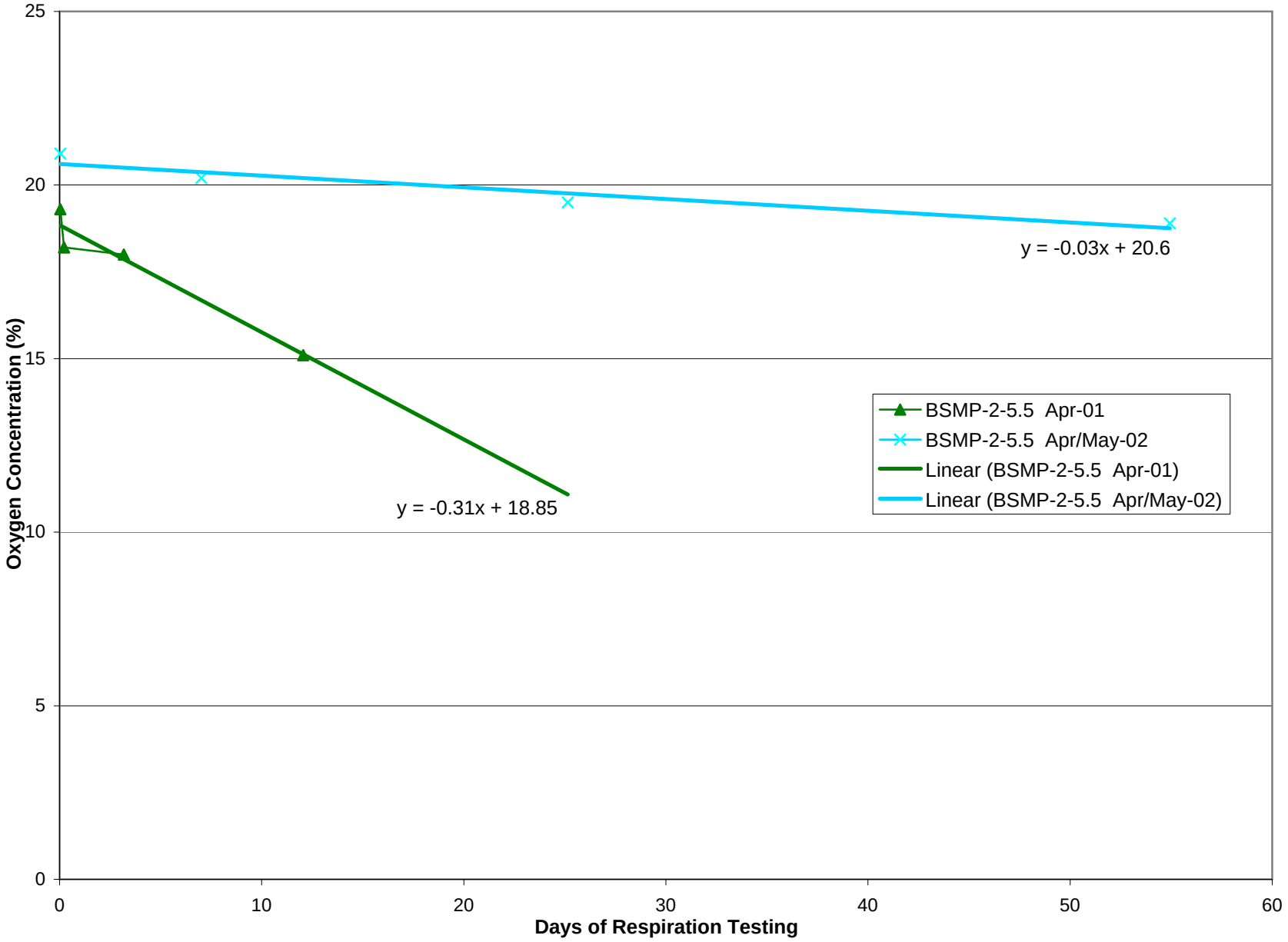


Figure 3-6
Oxygen Utilization at Site 2296 BSMP-2-5.5



SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

The following section presents conclusions, recommendations and the project schedule for Site 2296.

4.1 CONCLUSIONS

The following summarizes the results for the April 2005 groundwater-monitoring event and BS operation at Site 2296.

1) The hydraulic gradient calculated was 0.003 southwest. This is generally consistent with the last three years of groundwater monitoring, in which the flow direction has varied from southwest to west.
2) TPH-D was detected above the cleanup goal in one well, MW2296-5. The concentration in MW2296-5 was generally consistent with recent events.
3) No SVOC were detected at the site.
4) The depletion of electron acceptors (nitrate and sulfate), elevated concentrations of metabolic byproducts (methane), and low redox potential within the plume strongly indicate groundwater conditions in which biodegradation of fuel hydrocarbons is occurring.
5) Respiration test results collected since the February 2003 confirmation soil sampling indicate that oxygen is no longer being utilized within the vadose zone at this site, suggesting that residual soil contamination has been removed.

4.2 RECOMMENDATIONS

Based on the above evaluation, site closure is requested. The following actions will be performed while awaiting site closure.

1) Complete the 2nd semiannual groundwater monitoring event with the BS system remaining off to confirm that the TPH-D plume is stable or decreasing after turning off the BS system.
2) After completion of the 1-year verification monitoring period, again evaluate the potential for no further action based on the fact that there are no primary MCLs exceeding cleanup goals, and achieving the secondary MCL for TPH-D may be impractical at the site.

SECTION 5

REFERENCES

County of San Diego, Department of Health Services, 2002, *Site Assessment and Mitigation SAM Manual*.

Leeson, Andrea, and R. E. Hinchee, 1997. *Soil Bioventing: Principles and Practice*. Lewis Publishers, Boca Raton, FL.

OHM Remediation Services Corp., 1998, *Site 2296: Groundwater Monitoring Report-Second Quarter 1998,* June 1.

Parsons, 2000a, *Final Remediation Work Plan for Underground Storage Tank Site 2296, MCB Camp Pendleton, California,* January 17.

Parsons, 2000b, *Response to Comments, Final Remediation Work Plans for Sites 1121, 1131, 2404, 2296, 22187, 43302, 53435, and H-49 at Marine Corps Base Camp Pendleton, California; Comments from Regional Water Quality Control Board Dated 16 May 2000*, June 28.

Parsons, 2001a, *Letter Report on the Biosparging Remediation System Installation and Startup Results for Site 2296, Marine Corps Base Camp Pendleton, California*, August 8.

Parsons, 2001b, *Operation & Maintenance (O&M) Manual for Bioventing and Biosparging Systems; Remediation Project: Underground Storage Tank Sites 1121, 2296, 22187, 43302, 53435, and H-49, Marine Corps Base, Camp Pendleton, California*, July 3.

Parsons, 2002, *Remediation Verification Sampling Work Plan, Underground Storage Tank Site 2296, Marine Corps Base Camp Pendleton, California*, October 29.

Parsons, 2003, *Remediation Verification Sampling Report, Underground Storage Tank Site 2296, Marine Corps Base Camp Pendleton, California*, July 2.

United States Environmental Projection Agency (USEPA), 2004, *How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites,* 410-R-04-002, May 1995, updated May 2004.

APPENDIX A

HISTORICAL DATA

Table A-1

Historical Groundwater Elevations, Site 2296, MCB Camp Pendleton

WELL	DATE	Well Head Elevation	Depth to Water	Depth to Product	Product Thickness	Corrected GW Elevation
UNITS:		(feet above MSL)	(feet)	(feet)	(feet)	(feet above MSL)
MW1	3/18/97	63.63	6.40	ND	0.00	57.23
MW1	6/17/97		7.79	ND	0.00	55.84
MW1	10/27/97		10.68	ND	0.00	52.95
MW1	2/4/98		9.06	ND	0.00	54.57
MW1	4/6/98		6.43	ND	0.00	57.20
MW2	3/18/97	64.22	7.12	ND	0.00	57.10
MW2	6/17/97		8.72	ND	0.00	55.50
MW2	10/28/97		11.46	ND	0.00	52.76
MW2	2/4/98		9.32	ND	0.00	54.90
MW2	4/6/98		6.98	ND	0.00	57.24
MW3	3/18/97	64.02	6.95	ND	0.00	57.07
MW3	6/16/97		8.36	ND	0.00	55.66
MW3	10/27/97		11.21	ND	0.00	52.81
MW3	2/4/98		9.65	ND	0.00	54.37
MW3	4/6/98		7.01	ND	0.00	57.01
MW4	10/27/97	63.84	10.78	ND	0.00	53.06
MW4	2/4/98		9.49	ND	0.00	54.35
MW4	4/6/98		6.77	ND	0.00	57.07
MW5	10/27/97	64.10	11.18	ND	0.00	52.92
MW5	2/4/98		9.28	ND	0.00	54.82
MW5	4/6/98		6.84	ND	0.00	57.26
MW6	10/27/97	64.07	11.37	ND	0.00	52.70
MW6	2/4/98		9.13	ND	0.00	54.94
MW6	4/6/98		6.83	ND	0.00	57.24

Explanation:
GW = Groundwater
ND = Not detected

OHM Remediation Services Corp.

Metcalf & Eddy, Inc.

Table A-2

Historical Hydrocarbons in Groundwater, Site 2296, MCB Camp Pendleton

	CONSTITUENT:	TPH-D	TPH-M	Benzene	Toluene	Ethylbenzen	Xylenes
	METHOD:	M8015 LUFT	M8015 LUFT	EPA-8020	EPA-8020	EPA-8020	EPA-8020
	UNITS:	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L
WELL	SAMPLE DATE						
B1-GW1	6/21/95	26	NA	<0.5	<0.5	<0.5	<1.5
B2-GW1	6/21/95	<2	NA	<0.5	<0.5	<0.5	<1.5
B3-GW1	6/21/95	<2	NA	<0.5	<0.5	<0.5	<1.5
B4-GW1	6/27/95	<2	NA	<0.5	<0.5	<0.5	<1.5
B5-GW1	8/31/95	3	NA	<0.5	<0.5	<0.5	<1.5
B6-GW1	8/31/95	<2	NA	<0.5	<0.5	<0.5	<1.5
B7-GW1	8/31/95	<2	NA	<0.5	<0.5	<0.5	<1.5
B8-GW1	8/31/95	0.97	NA	<0.5	<0.5	<0.5	<1.5
B9-GW1	9/1/95	0.87	NA	<0.5	<0.5	<0.5	<1.5
B10-GW1	9/1/95	<2	NA	<0.5	<0.5	<0.5	<1.5
HP1	028 2/27/97	5.4 B	NA	<0.5	<0.5	<0.5	2.0 <1.5
HP2	024 2/27/97	70 B	NA	<0.5	<0.5	<0.5	<0.5
HP3	019 2/27/97	<0.5	NA	<0.5	<0.5	<0.5	25 J
HP1	433 10/15/97	0.6	0.3 J	<0.5	<0.5	<0.5	<0.5
HP2	438 10/17/97	0.7	0.2 J	<0.5	<0.5	<0.5	<1.5
HP3	437 10/17/97	0.6	0.3 J	<0.5	<0.5	<0.5	<1.5
MW1	9/20/95	<0.5	NA	<0.5	<0.5	<0.5	<1.5
MW1	042 3/19/97	<0.5	NA	<0.5	<0.5	<0.5	<1.5
MW1	385 6/20/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW1	441 10/27/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW1	442 10/27/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW1	507 2/4/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW1	574 4/6/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW2	9/20/95	<0.5	NA	<0.5	1.4	<0.5	<1.5
MW2	043 3/19/97	<0.5	NA	<0.5	<0.5	<0.5	<1.5
MW2	383 6/20/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW2	443 10/27/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW2	508 2/4/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW2	575 4/6/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW3	9/20/95	<0.5	NA	<0.5	5.6	<0.5	<1.5
MW3	041 3/19/97	<0.5	NA	<0.5	<0.5	<0.5	<1.5
MW3	379 6/18/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW3	444 10/27/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW3	509 2/4/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW3	576 4/6/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW4	435 10/15/97	0.6	0.3 J	<0.5	<0.5	<0.5	<1.5
MW4	440 10/27/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW4	510 2/4/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW4	577 4/6/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW5	432 10/15/97	0.7	0.3 J	<0.5	<0.5	<0.5	0.7 J
MW5	445 10/27/97	2.8	<0.5	<0.5	<0.5	<0.5	<1.5
MW5	511 2/4/98	2.2	<0.5	<0.5	<0.5	<0.5	<1.5
MW5	578 4/6/98	2.5[1]	<0.5	0.3 J	0.6	1.3	3.3
MW6	434 10/15/97	2.8	0.5	<0.5	<0.5	<0.5	<1.5
MW6	446 10/27/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW6	514 2/4/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW6	515 2/4/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW6	581 4/6/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW6 (dupe)	582 4/6/98	<0.5	<0.5	<0.5	<0.5	<0.5	0.6 J

Explanation:

J = Estimated value
M8015E = Modified Method 8015 - Extractables
mg/L = milligrams per liter
NA = Not analyzed
TPH-D = Total Petroleum Hydrocarbons as Diesel
TPH-M = Total Petroleum Hydrocarbons as Motor Oil
µg/L = micrograms per liter
[1] *Mixture of jet fuel and diesel*

Table A-3

Historical Bioremediation Activity Indicators (Lab Measurements), Site 2296, MCB Camp Pendleton

CONSTITUENT:			Alk	Ammonia	Nitrate	Nitrite	TKN	Phos	PH	Sulfate	Fe	Methane	Sulfide
METHOD:			310.1	350.2	300.0	300.0	351.3	300.0	9040	300.0	7380	GC/FID	376.2
		UNITS:	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH unit	mg/L	mg/L	µg/L	mg/L
WELL	SAMPLE	DATE											
HP1	028	2/26/97	NA	NA	<0.04	<0.05	17.4	NA	7.48	NA	NA	1260	<0.2
HP2	024	2/26/97	NA	NA	0.07	<0.05	15.6	NA	7.38	NA	NA	150	<0.2
HP3	019	2/26/97	NA	NA	12.8	<0.05	4.5	NA	7.24	NA	NA	<3	<0.2
MW1	042	3/19/97	1920	NA	<0.2	<0.25	1.0	NA	7.44	544	0.115	109	<0.2
MW1	385	6/20/97	1990	NA	<2	<2.5	1.0	<5	7.25	610	3.4 J	144	<0.2
MW1	441	10/27/97	1980	NA	<1.6	<2	1.4	<4	NA	495	<0.1	141	NA
MW1	507	2/4/98	1950	NA	<2	<2.5	NA	<5	NA	500	0.216	180	NA
MW1	574	4/6/98	1910	NA	<3.2	<4	NA	<8	NA	630	0.0784	43.8	NA
MW2	043	3/19/97	635	NA	<0.04	<0.05	1	NA	7.13	162	0.130	10	<0.2
MW2	383	6/20/97	728	NA	0.44	<0..5	0.44	<1	7.06	176	2.8	20.9	<0.2
MW2	443	10/27/97	799	NA	<0.4	<0.5	0.62	<1	NA	147	<0.1	33	NA
MW2	508	2/4/98	209	NA	0.37	<0.1	NA	<0.2	NA	16	0.676	<3	NA
MW2	575	4/6/98	659	NA	<0.4	<0.5	NA	<1	NA	172	0.282	11.2	NA
MW3	041	3/19/97	1310	NA	<0.2	<0.25	0.7	NA	7.35	600	0.212	407	<0.2
MW3	379	6/18/97	1320	0.48	<2	<2.5	0.66	<5	7.44	646	2.6	540	<0.2
MW3	444	10/27/97	1230	NA	<2	<2.5	1.1	<5	NA	589	<0.1	284	NA
MW3	509	2/4/98	1270	NA	<2	<2.5	NA	<5	NA	582	0.269	630	NA
MW3	576	4/6/98	1270	NA	<3.2	<4	NA	<8	NA	700	0.0927	3.83	NA
MW4	440	10/27/97	1530	NA	<1	<1.3	0.87	<2.5	NA	419	<0.1	8.2	NA
MW4	510	2/4/98	1580	NA	<1.6	<2	NA	<4	NA	380	0.0808	1100	NA
MW4	577	4/6/98	1630	NA	<1.6	<2	NA	<4	NA	455	0.0234 J	43.5	NA
MW5	445	10/27/97	1420	NA	<0.5	<0.63	2.0	<1.25	NA	183	0.24	2 J	NA
MW5	511	2/4/98	970	NA	<0.16	<0.2	NA	<0.4	NA	35	0.814	2200	NA
MW5	578	4/6/98	724	NA	0.19	<0.05	NA	0.1	NA	22.3	0.964	1330	NA
MW6	446	10/27/97	706	NA	0.63	<0.5	1.6	<1.0	NA	153	0.10	21	NA
MW6	514	2/4/98	710	NA	<1.6	<2	NA	<4	NA	170	0.723	62	NA
MW6	581	4/6/98	724	NA	<0.5	<0.63	NA	<1.3	NA	153	0.721	42.1	NA

Explanation:

Alk = Alkalinity
Fe = Iron
GC/FID = Gas Chromatograph/Flame Ionization Detector
J = Estimated value
mg/L = milligrams per liter
NA = Not Analyzed
Phos = Phosphate
TKN = Total Kjeldahl Nitrogen
µg/L = micrograms per liter

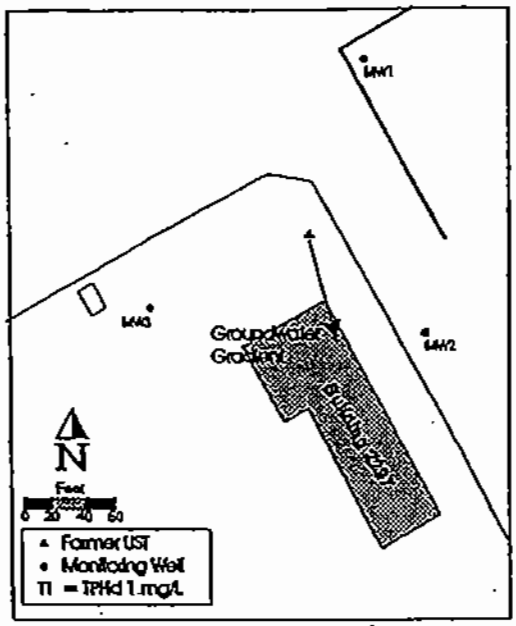
Table A-4

Historical Bioremediation Activity Indicators (Field Measurements), Site 2296
MCB Camp Pendleton

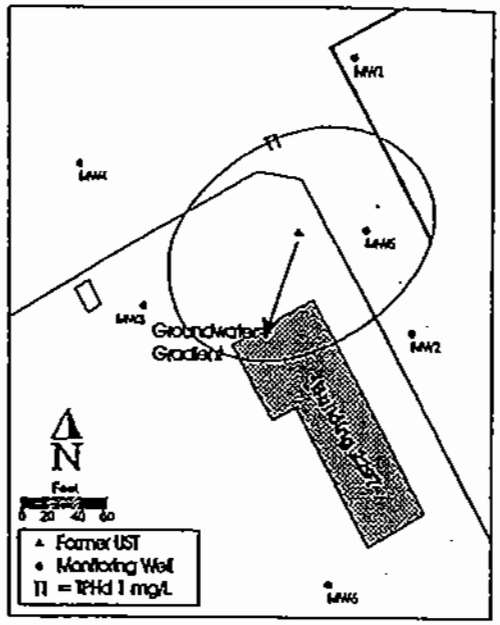
CONSTITUENT:		Dissolved O2	Redox (Orion)	Redox (ORP)	Ferrous Iron	Sulfide
	UNITS:	mg/L	mV	mV	mg/L	mg/L
WELL	DATE					
MW1	6/17/97	NA	NA	NA	NA	<0.2
MW1	10/27/07	3.70	155	30	ND	ND
MW1	2/4/98	1.40	NA	78	ND	ND
MW1	4/6/98	2.68	NA	136	NM	NM
MW2	6/17/97	NA	NA	NA	NA	<0.2
MW2	10/27/97	1.90	85	80	ND	ND
MW2	2/4/98	1.82	NA	67	ND	ND
MW2	4/6/98	NA	NA	127	ND	ND
MW3	6/17/97	NA	NA	NA	NA	<0.2
MW3	10/27/97	3.50	270	60	ND	ND
MW3	2/4/98	0.62	NA	67	ND	ND
MW3	4/6/98	0.56	NA	126	0.01	ND
MW4	10/27/97	5.90	173.6	50	ND	ND
MW4	2/4/98	3.96	NA	85	ND	ND
MW4	4/6/98	3.86	NA	161	ND	ND
MW5	10/27/97	4.70	50	70	ND	ND
MW5	2/4/98	1.97	NA	52	0.5	ND
MW5	4/6/98	2.20	NA	-5	ND	ND
MW6	10/27/97	1.95	60	80	ND	ND
MW6	2/4/98	6.68	NA	43	0.8	ND
MW6	4/6/98	0.38	NA	58	0.4	ND

Explanation:
mg/L = milligrams per liter
mV = millivolts
NA = Not analyzed
NM = Not measured

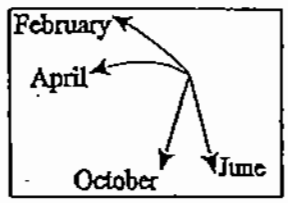
Figure A-1 Historical Groundwater Gradient and Contaminant Distribution at Site 2296.



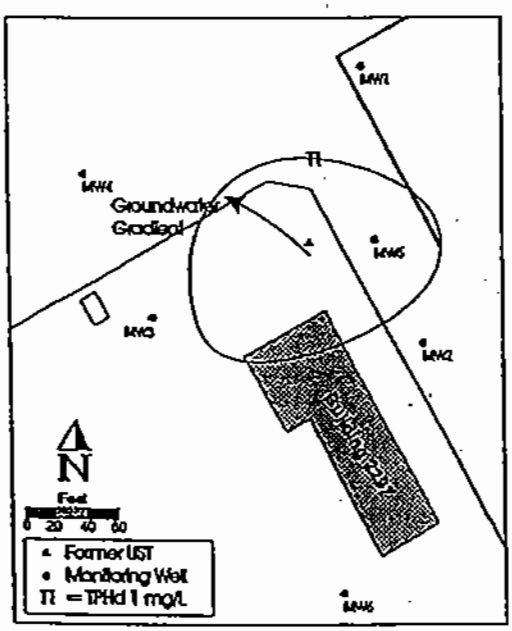
June 1997



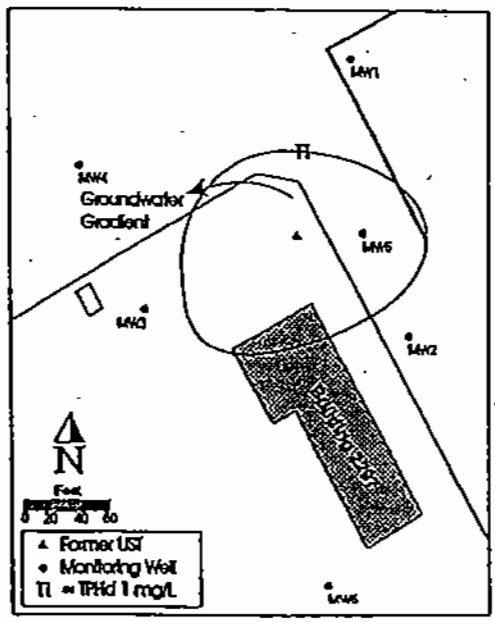
October 1997



Interpreted Groundwater Flow Direction



February 1998



April 1998

Table 16
Hydrocarbons in Soil at Site 2296
MCB Camp Pendleton

			B1	B1	B1	B1	B1	B1	B2	B2	B2	B2	B3
Depth (feet bgs)			6	7.5	12	15	17.5	20	6	12	15	20	6
Date			6/21/95	6/21/95	6/21/95	6/21/95	6/21/95	6/21/95	6/21/95	6/21/95	6/21/95	6/21/95	6/21/95
CONSTITUENT	METHOD	UNITS											
TPH-D	M8015E	mg/kg	<10	<10	190	<10	<10	<10	<10	480	<10	<10	<10
TPH-M	M8015E	mg/kg	-	-	18	-	-	-	-	58	-	-	-
TRPH	418.1	mg/kg	-	-	-	-	-	-	-	-	-	-	-
Benzene	LUFT-8020	µg/kg	-	-	<0.1	-	-	-	-	<0.5	-	-	-
Toluene	LUFT-8020	µg/kg	-	-	<0.1	-	-	-	-	<0.5	-	-	-
Ethylbenzene	LUFT-8020	µg/kg	-	-	<0.1	-	-	-	-	<0.5	-	-	-
O-Xylenes	LUFT-8020	µg/kg	-	-	<0.1	-	-	-	-	<0.15	-	-	-
SPLP TPH-D	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP TPH-M	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Benzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Toluene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Ethylbenzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Xylenes	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-

Table 16
Hydrocarbons in Soil at Site 2296
MCB Camp Pendleton

			B3	B3	B3	B3	B4	B4	B4	B4	B4	B4	B5
Depth (feet bgs)			10	12	15	20	6	7.5	12.5	15	20	25	5
Date			6/21/95	6/21/95	6/21/95	6/21/95	6/26/95	6/26/95	6/26/95	6/26/95	6/26/95	6/26/95	8/30/95
CONSTITUENT	METHOD	UNITS											
TPH-D	M8015E	mg/kg	530	360	31	<10	<10	<10	1000	<10	<10	<10	<10
TPH-M	M8015E	mg/kg	53	-	-	-	-	-	380	-	-	-	-
TRPH	418.1	mg/kg	-	-	-	-	-	-	-	-	-	-	-
Benzene	LUFT-8020	µg/kg	<0.5	-	-	-	-	-	<1	-	-	-	-
Toluene	LUFT-8020	µg/kg	<0.5	-	-	-	-	-	<1	-	-	-	-
Ethylbenzene	LUFT-8020	µg/kg	<0.5	-	-	-	-	-	<1	-	-	-	-
O-Xylenes	LUFT-8020	µg/kg	<0.15	-	-	-	-	-	<1.3	-	-	-	-
SPLP TPH-D	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP TPH-M	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Benzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Toluene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Ethylbenzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Xylenes	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-

Table 16
Hydrocarbons in Soil at Site 2296
MCB Camp Pendleton

			B5	B5	B5	B5	B5	B6	B6	B6	B6	B6	B7
Depth (feet bgs)			7.5	10	12.5	15	20	5	7.5	10	12.5	15	5
Date			8/30/95	8/30/95	8/30/95	8/30/95	8/30/95	8/31/95	8/31/95	8/31/95	8/31/95	8/31/95	8/31/95
CONSTITUENT	METHOD	UNITS											
TPH-D	M8015E	mg/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TPH-M	M8015E	mg/kg	-	-	-	-	-	-	-	-	-	-	-
TRPH	418.1	mg/kg	-	-	-	-	-	-	-	-	-	-	-
Benzene	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
Toluene	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
O-Xylenes	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
SPLP TPH-D	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP TPH-M	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Benzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Toluene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Ethylbenzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Xylenes	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-

Table 16
Hydrocarbons in Soil at Site 2296
MCB Camp Pendleton

			B7	B7	B7	B7	B7	B8	B8	B8	B8	B8	B8
Depth (feet bgs)			7.5	10	12.5	15	20	5	7.5	10	12.5	15	20
Date			8/31/95	8/31/95	8/31/95	8/31/95	8/31/95	8/31/95	8/31/95	8/31/95	8/31/95	8/31/95	8/31/95
CONSTITUENT	METHOD	UNITS											
TPH-D	M8015E	mg/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TPH-M	M8015E	mg/kg	-	-	-	-	-	-	-	-	-	-	-
TRPH	418.1	mg/kg	-	-	-	-	-	-	-	-	-	-	-
Benzene	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
Toluene	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
O-Xylenes	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
SPLP TPH-D	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP TPH-M	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Benzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Toluene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Ethylbenzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Xylenes	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-

Table 16
Hydrocarbons in Soil at Site 2296
MCB Camp Pendleton

			B9	B9	B9	B9	B9	B9	B10	B10	B10	B10	B10
Depth (feet bgs)			5	7.5	10	12.5	15	20	5	7.5	10	12.5	15
Date			9/1/95	9/1/95	9/1/95	9/1/95	9/1/95	9/1/95	9/1/95	9/1/95	9/1/95	9/1/95	9/1/95
CONSTITUENT	METHOD	UNITS											
TPH-D	M8015E	mg/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TPH-M	M8015E	mg/kg	-	-	-	-	-	-	-	-	-	-	-
TRPH	418.1	mg/kg	-	-	-	-	-	-	-	-	-	-	-
Benzene	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
Toluene	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
O-Xylenes	LUFT-8020	µg/kg	-	-	-	-	-	-	-	-	-	-	-
SPLP TPH-D	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP TPH-M	M8015E	mg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Benzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Toluene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Ethylbenzene	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-
SPLP Xylenes	LUFT-8020	µg/L	-	-	-	-	-	-	-	-	-	-	-

Table 16
Hydrocarbons in Soil at Site 2296
MCB Camp Pendleton

			B10	RB1-027	RB1-029	RB1-030	RB2-023	RB2-025	RB2-026	RB3-018	RB3-020
Depth (feet bgs)			20	8	12	17	8	12	17	8	12
Date			9/1/95	2/26/97	2/26/97	2/26/97	2/26/97	2/26/97	2/26/97	2/26/97	2/26/97
CONSTITUENT	METHOD	UNITS									
TPH-D	M8015E	mg/kg	<10	<12	315 B	<13	<12	1100 B	<13	<13	585 B
TPH-M	M8015E	mg/kg	-	-	-	-	-	-	-	-	-
TRPH	418.1	mg/kg	-	-	-	-	-	-	-	-	-
Benzene	LUFT-8020	µg/kg	-	-	<13	-	-	<13	-	-	<13
Toluene	LUFT-8020	µg/kg	-	-	59	-	-	20	-	-	<13
Ethylbenzene	LUFT-8020	µg/kg	-	-	91	-	-	45	-	-	120
O-Xylenes	LUFT-8020	µg/kg	-	-	725	-	-	365	-	-	250
SPLP TPH-D	M8015E	mg/L	-	-	<0.5	-	-	0.8	-	-	<0.5
SPLP TPH-M	M8015E	mg/L	-	-	-	-	-	-	-	-	-
SPLP Benzene	LUFT-8020	µg/L	-	-	<0.5	-	-	<0.5	-	-	<0.5
SPLP Toluene	LUFT-8020	µg/L	-	-	<0.5	-	-	<0.5	-	-	<0.5
SPLP Ethylbenzene	LUFT-8020	µg/L	-	-	<0.5	-	-	<0.5	-	-	<0.5
SPLP Xylenes	LUFT-8020	µg/L	-	-	<1.5	-	-	<1.5	-	-	<1.5

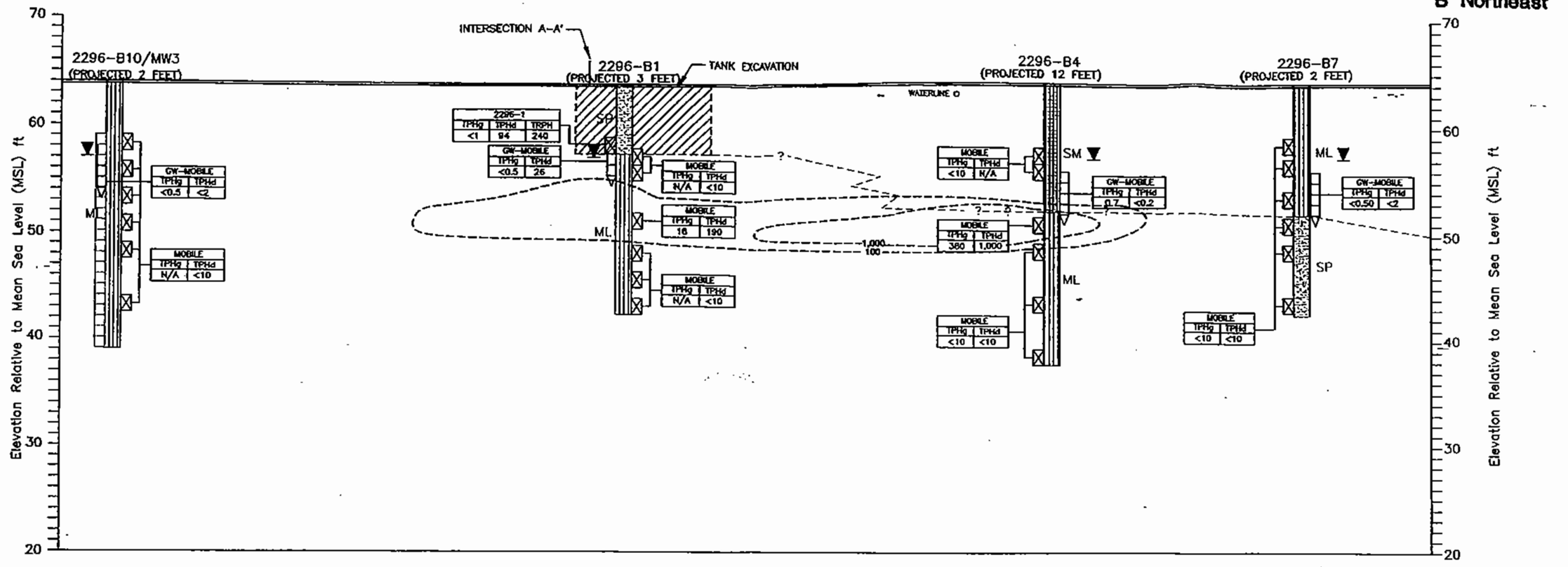
Table 16
Hydrocarbons in Soil at Site 2296
MCB Camp Pendleton

			RB3-021
Depth (feet bgs)			17
Date			2/26/97
CONSTITUENT	METHOD	UNITS	
TPH-D	M8015E	mg/kg	<13
TPH-M	M8015E	mg/kg	-
TRPH	418.1	mg/kg	-
Benzene	LUFT-8020	µg/kg	-
Toluene	LUFT-8020	µg/kg	-
Ethylbenzene	LUFT-8020	µg/kg	-
O-Xylenes	LUFT-8020	µg/kg	-
SPLP TPH-D	M8015E	mg/L	-
SPLP TPH-M	M8015E	mg/L	-
SPLP Benzene	LUFT-8020	µg/L	-
SPLP Toluene	LUFT-8020	µg/L	-
SPLP Ethylbenzene	LUFT-8020	µg/L	-
SPLP Xylenes	LUFT-8020	µg/L	-

Notes:
bgs : below ground surface
B : Mixture of JP-5 and diesel.
J : Estimated value.
LUFT : Leaking Underground Fuel Tank
M8015E : Modified Method 8015
- Extractables
mg/Kg : milligrams per Kilogram
mg/L : milligrams per Liter
SPLP : Synthetic Precipitation Leaching Procedure
TPH-D : Total Petroleum Hydrocarbons as Diesel
TPH-M : Total Petroleum Hydrocarbons as Motor Oil
TRPH : Total Recoverable Petroleum Hydrocarbons
µg/Kg : micrograms per Kilogram
µg/L : micrograms per Liter
"-" : Not Analyzed

CROSS-SECTION B-B'
(View Looking Northwest)

B Southwest — **B' Northeast**



LEGEND

GW,GP,GM,GC	GRAVELS	SC	CLAYEY SANDS
SW	WELL GRADED SANDS	ML	SILTS
SP	POORLY GRADED SANDS	CL	CLAYS
SM	SILTY SANDS	OH	ORGANIC CLAYS AND SILTS

- TANK CAVITY BACKFILL
- ASPHALT PAVEMENT
- HYDROPUNCH OR TEMPORARY WELL SCREEN INTERVAL
- ANALYTICAL SOIL SAMPLE
- MONITORING WELL SCREEN INTERVAL
- GROUNDWATER TABLE

GW GROUNDWATER SAMPLE

N/A=NOT ANALYZED
ND=NOT DETECTED
TPHd=TOTAL PETROLEUM HYDROCARBONS DIESEL OR SEMI-VOLATILE RANGE (mg/kg-SOIL,mg/L-WATER)
TPHd=TOTAL PETROLEUM HYDROCARBONS GAS OR VOLATILE RANGE (mg/kg-SOIL,mg/L-WATER)

----100---- TPHd COUTOUR

MOBILE=ANALYSIS BY MOBILE LABORATORY
STA=ANALYSIS BY STATIONARY LABORATORY

----- LITHOLOGIC CONTACT

0 5 10
VERTICAL SCALE IN FEET

0 5 10
HORIZONTAL SCALE IN FEET

APPENDIX A

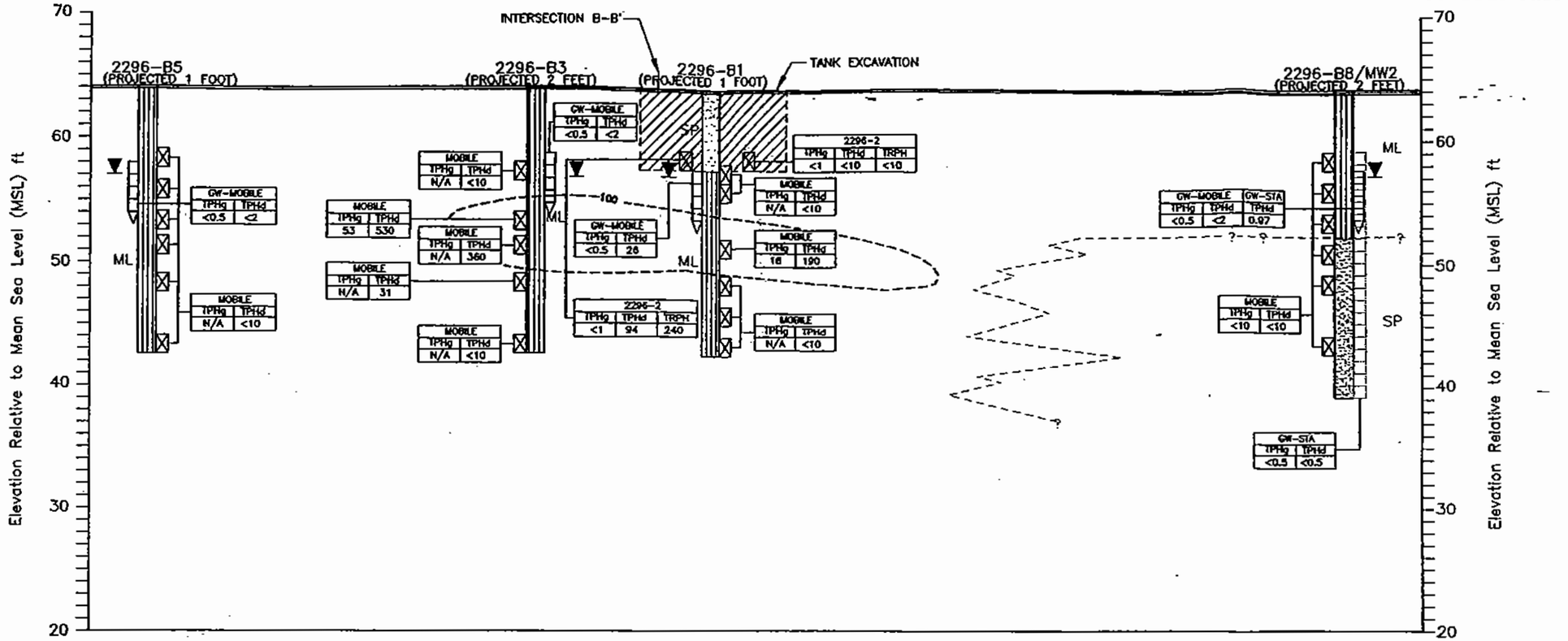
FIGURE 3-4
CROSS-SECTION B-B'
UST SITE 2296

PROJECT LOCATION	DATE	PROJECT NUMBER
BUILDING 2296 CAMP PENDLETON, CALIFORNIA	APRIL 1996	1801-17

BROWN AND CALDWELL
SAN DIEGO, CALIFORNIA

RAC 1801813.DWG

CROSS-SECTION A-A'
(View Looking Northeast)



LEGEND

GW,GP,GM,GC	GRAVELS	SC	CLAYEY SANDS
SW	WELL GRADED SANDS	ML	SILTS
SP	POORLY GRADED SANDS	CL	CLAYS
SM	SILTY SANDS	OH	ORGANIC CLAYS

- TANK CAVITY BACKFILL
- ASPHALT PAVEMENT
- HYDROPUNCH OR TEMPORARY WELL SCREEN INTERVAL
- ANALYTICAL SOIL SAMPLE
- MONITORING WELL SCREEN INTERVAL
- GROUNDWATER TABLE

GW GROUNDWATER SAMPLE

N/A=NOT ANALYZED
ND=NOT DETECTED
TPHd=TOTAL PETROLEUM HYDROCARBONS
DIESEL OR SEMI-VOLATILE RANGE
(mg/kg-SOIL,mg/L-WATER)
TPHg=TOTAL PETROLEUM HYDROCARBONS
GAS OR VOLATILE RANGE
(mg/kg-SOIL,mg/L-WATER)
----100---- TPHd CONTOUR

MOBILE= ANALYSIS BY MOBILE LABORATORY
STA= ANALYSIS BY STATIONARY LABORATORY

----- LITHOLOGIC CONTACT

0 5 10
VERTICAL SCALE IN FEET

0 5 10
HORIZONTAL SCALE IN FEET

APPENDIX A

FIGURE 3-3
CROSS-SECTION A-A'
UST SITE 2296

PROJECT LOCATION	DATE	PROJECT NUMBER
BUILDING 2296 CAMP PENDLETON, CALIFORNIA	APRIL 1996	1801-17

BROWN AND CALDWELL
SAN DIEGO, CALIFORNIA

RAC 1801612.DWG

2296-B3				
DEPTH (ft)	Mobile			Stationary
	TPHg	TPHd	BTEX	PAHs
6.0	N/A	<10	N/A	N/A
10.0	53	530	ND(a)	<0.2
12.0	N/A	360	N/A	N/A
15.0	N/A	31	N/A	N/A
20.0	N/A	<10	N/A	N/A

2296-B5	
DEPTH (ft)	Mobile TPHd
5.0	<10
7.5	<10
10.0	<10
12.5	<10
15.0	<10
20.0	<10

2296-B6/MW1	
DEPTH (ft)	Mobile TPHd
5.0	<10
7.5	<10
10.0	<10
12.5	<10
15.0	<10
20.0	<10

2296-1		
DEPTH	TPHd	TRPH
8"	94	240

2296-B4			
DEPTH (ft)	Mobile		
	TPHg	TPHd	BTEX
6.0	N/A	<10	N/A
7.5	N/A	<10	N/A
12.5	380	1000	T=1.3"
15.0	N/A	<10	N/A
20.0	N/A	<10	N/A
25.0	N/A	<10	N/A

2296-B1				
DEPTH (ft)	Mobile			Stationary
	TPHg	TPHd	BTEX	PAHs
6.0	N/A	<10	N/A	N/A
7.5	N/A	<10	N/A	N/A
12.0	18	190	ND(a)	<0.2
15.0	N/A	<10	N/A	N/A
17.5	N/A	<10	N/A	N/A
20.0	N/A	<10	N/A	N/A

2296-B7	
DEPTH (ft)	Mobile TPHd
5.0	<10
7.5	<10
10.0	<10
12.5	<10
15.0	<10
20.0	<10

2296-B10/MW3	
DEPTH (ft)	Mobile TPHd
5.0	<10
7.5	<10
10.0	<10
12.5	<10
15.0	<10
20.0	<10

2296-2		
DEPTH	TPHd	TRPH
9"	<10	<10

2296-B2				
DEPTH (ft)	Mobile			Stationary
	TPHg	TPHd	BTEX	PAHs
6.0	N/A	<10	N/A	N/A
12.0	58	480	ND(a)	<0.2
15.0	N/A	<10	N/A	N/A
20.0	N/A	<10	N/A	N/A

2296-B9	
DEPTH (ft)	Mobile TPHd
5.0	<10
7.5	<10
10.0	<10
12.5	<10
15.0	<10
20.0	<10

2296-B8/MW2	
DEPTH (ft)	Mobile TPHd
5.0	<10
7.5	<10
10.0	<10
12.5	<10
15.0	<10
20.0	<10

LEGEND

- TREE
- SOIL SAMPLE COLLECTED DURING TANK EXCAVATION
- SOIL BORING
- MONITORING WELL
- CHAIN LINK FENCE
- OE OVERHEAD ELECTRIC
- PP POWER POLE
- UW UNDERGROUND WATER
- STMH STORM DRAIN MANHOLE
- SSMH SANITARY SEWER MANHOLE
- APPROXIMATE LIMIT OF SOIL POTENTIALLY CONTAINING DIESEL RANGE HYDROCARBONS TPHd ABOVE 100 mg/kg.

TPHd=TOTAL PETROLEUM HYDROCARBONS DIESEL OR SEMI-VOLATILE RANGE (mg/kg)
TPHg=TOTAL PETROLEUM HYDROCARBONS GAS OR VOLATILE RANGE (mg/kg)
PAH=POLYNUCLEAR AROMATIC HYDROCARBONS(mg/kg)
BTEX=B=BENZENE, T=TOLUENE, E=ETHYLBENZENE, X=TOTAL XYLENES (mg/kg).
N/A=NOT ANALYZED
ND=NOT DETECTED

(a)=VARIABLE DEPENDING ON COMPOUND (RANGE FROM <0.05 TO <0.15mg/kg)

A. C. PAVING
GRATED INLET
A.C. BERM
2" DIA. INLET
GRATED INLET
UW
OE
PP
VENT
6' CHAIN LINK FENCE
SSMH
A.C. PATCH
STMH
STMH
UST SITE 2296
DIRT
CONCRETE GENERATOR PAD
GUY ANCHOR
8' CHAIN LINK FENCE
A.C. PAVING
A.C. BERM
6' CHAIN LINK FENCE
BUILDING 2296
BUILDING 2297
APPROXIMATE GROUNDWATER GRADIENT DIRECTION
A. C. PAVING
DIRT

0 10 20
SCALE IN FEET

BENCHMARK:
CAMP PENDLETON N.A.D. 83 CONTROL PT. NO. 101
A BRASS DISK SET IN AN ALUMINUM MONUMENT WELL LOCATED ON THE CENTERLINE OF VANDERGRIFT BOULEVARD, 120 FEET± NORTHEASTERLY OF THE NORTHWESTERLY PROLONGATION OF THE SOUTHWESTERLY BUILDING LINE OF BUILDING NO. 2237.

N.A.V.D. 1988 ELEVATION = 59.88

LAY 1801B10.DWG

APPENDIX A

FIGURE 3-2

SOIL SAMPLE RESULTS UST SITE 2296

PROJECT LOCATION	DATE	PROJECT NUMBER
BUILDING 2296 CAMP PENDLETON, CALIFORNIA	APRIL 1996	1801-17

BROWN AND CALDWELL
SAN DIEGO, CALIFORNIA

APPENDIX B

GROUNDWATER SAMPLING SHEETS

AND WASTE MANIFESTS

WELL GAUGING DATA

Project # 050411-01 Date 4/14/05 Client Parsons @ Camp Pendleton

Site Area 2296

Well ID	Well Size (in.)	Sheen / Odor	Depth to Immiscible Liquid (ft.)	Thickness of Immiscible Liquid (ft.)	Volume of Immiscibles Removed (ml)	Depth to water (ft.)	Depth to well bottom (ft.)	Survey Point: TOB or TOC	*
MW 2296-1	4					5.65	24.35	TOC	X
MW 2296-2	4					6.62	25.32		X
MW 2296-3	4					6.27	25.05		
MW 2296-4	4					6.17	21.12		X
MW 2296-5	4					6.35	20.40		
MW 2296-6	4					6.65	19.94		

4 = Gauged With Stinger in Well

WELL MONITORING DATA SHEET

Project #: 050411-001	Client: Parsons @ Camp Pendleton BAA
Sampler: CD	Start Date: 4/15/05
Well I.D.: MW2296-1	Well Diameter: 2 3 (4) 6 8 ___
Total Well Depth: 24.35	Depth to Water Pre: 5.65 Post: 23.82
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: (PVC) Grade	Flow Cell Type: YSI 556

Purge Method: (2" Grundfos Pump) Peristaltic Pump Bladder Pump 9.39
Sampling Method: Dedicated Tubing (Disposable Bailer) Other ___

Flow Rate: 2 GPM Pump Depth: 23'

12.2 (Gals.) X 3 = 36.6 Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
754	Start Purge							
756	22.98	7.55	2470	7	0.63	-45.3	4	
758	22.53	7.54	2321	6	0.91	-40.9	8	
800	22.46	7.50	2435	5	0.65	-42.8	12	
802	22.52	7.52	2590	7	0.68	-44.0	16	
804	22.68	7.53	2991	6	0.30	-44.8	20	
806	23.18	7.45	4737	6	0.29	-47.9	24	
809	23.64	7.40	5330	6	0.30	-48.8	~~28~~ 30	
813	23.67	7.41	5420	4	0.31	-49.1	37	

Did well dewater? Yes (No) Amount actually evacuated: 37

Sampling Time: 1805 Sampling Date: 4/15/05 Depth to Water: 5.95

Sample I.D.: MW2296-1-0405 Laboratory: APCL

Analyzed for: TPH-G BTEX MTBE (TPH-D) Other: See COC

Equipment Blank I.D.: @ Time Duplicate I.D.:

WELL MONITORING DATA SHEET

Project #: 050411-01	Client: Parsons @ Camp Pendleton BAA
Sampler: CD	Start Date: 4/15/05
Well I.D.: MW2296-2	Well Diameter: 2 3 (4) 6 8 ____
Total Well Depth: 25.32	Depth to Water Pre: 6.62 Post: 6.83
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: (PVC) Grade	Flow Cell Type: YSI 556

Purge Method: 2" Grundfos Pump | Peristaltic Pump | Bladder Pump | 10.36
Sampling Method: Dedicated Tubing | (Disposable Bailer) | Other ____

Flow Rate: 2GPM | Pump Depth: 22'

12.2 (Gals.) X 3 = 36.6 Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
822	- Start Purge							
824	23.28	7.19	3006	72	0.13	-26.2	4	
826	23.30	7.20	3002	46	0.14	-26.5	8	
828	23.29	7.20	2998	14	0.15	-26.7	12	
830	23.32	7.19	2992	10	0.15	-27.3	16	
832	23.38	7.19	2983	10	0.11	-27.3	20	
836	23.40	7.18	2984	7	0.10	-31.1	29	
838	23.40	7.18	2982	4	0.10	-32.2	32	
841	23.41	7.18	2980	3	0.10	-33.3	37	

Did well dewater? Yes (No) | Amount actually evacuated: 37

Sampling Time: 846 | Sampling Date: 4/15/05 | Depth to Water: 6.83

Sample I.D.: MW2296-2-0405 | Laboratory: APCL

Analyzed for: TPH-G BTEX MTBE (TPH-D) | Other: See Soil

Equipment Blank I.D.: @ Time | Duplicate I.D.:

WELL MONITORING DATA SHEET

Project #: 050411-01	Client: Parsons @ Camp Pendleton BAA
Sampler: CO	Start Date: 4/5/05
Well I.D.: MW2296-3	Well Diameter: 2 3 (4) 6 8 ___
Total Well Depth: 25.05	Depth to Water Pre: 6.27 Post: 21.81
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: (PVC) Grade	Flow Cell Type: YSI 556

Purge Method: 2" Grundfos Pump | Peristaltic Pump | Bladder Pump | 10.02
Sampling Method: Dedicated Tubing | (Disposable Bailer) | Other ___

Flow Rate: 2 GPM | Pump Depth: 24'

12.2 (Gals.) X 3 = 36.6 Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
900	Start Purge							
902	22.03	7.21	6313	5	0.53	-30.0	4	
904	21.97	7.22	6297	3	0.47	-28.1	8	
907	21.91	7.22	6241	3	0.43	-22.9	14	
910	21.78	7.21	6171	2	0.22	-15.2	20	
913	22.20	7.19	6508	10	0.16	-27.5	26	
915	22.29	7.18	6520	7	0.14	-27.9	30	
917	22.31	7.17	6602	4	0.13	-28.2	34	
918	22.34	7.17	6615	4	0.13	-28.7	37	

Did well dewater? Yes (No) Amount actually evacuated: 37

Sampling Time: 1018 Sampling Date: 4/5/05 Depth to Water: 7.60

Sample I.D.: MW2296-3-0405 Laboratory: APCL

Analyzed for: TPH-G BTEX MTBE (TPH-D) Other: See SOW

Equipment Blank I.D.: @ Time Duplicate I.D.:

WELL MONITORING DATA SHEET

Project #: 05041-001	Client: Parsons @ Camp Pendleton BAA
Sampler: CJ	Start Date: 4/15/05
Well I.D.: MW2296-5	Well Diameter: 2 3 (4) 6 8 ____
Total Well Depth: 20.40	Depth to Water Pre: 6.35 Post: 9.17
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: (PVC) Grade	Flow Cell Type: YSI 556

Purge Method: 2" Grundfos Pump | Peristaltic Pump | Bladder Pump 9.16
Sampling Method: Dedicated Tubing | (Disposable Bailer) | Other ____

Flow Rate: 2 GPM

Pump Depth: 20.0'

9.1 (Gals.) X 3 = 27.3 Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
950	— Start Purge —							
952	21.46	7.42	1545	36	~~0.752~~ 0.24	-43.2	4	
954	21.38	7.47	1534	22	0.15	-72.4	8	
955	21.34	7.47	1550	20	0.13	-74.1	10	
957	21.49	7.32	1490	16	0.21	-105.6	14	
959	21.57	7.35	1705	8	0.79	-110.2	18	Well dewatered

Did well dewater? (Yes) No Amount actually evacuated: 18

Sampling Time: 1055 Sampling Date: 4/15/05 Depth to Water: 9.15

Sample I.D.: MW2296-5-0405 Laboratory: APC

Analyzed for: TPH-G BTEX MTBE (TPH-D) Other: See SOW, PNAs

Equipment Blank I.D.: @ Time Duplicate I.D.:

WELL MONITORING DATA SHEET

Project #: 050411-001	Client: Parsons @ Camp Pendleton BAA
Sampler: CA	Start Date: 4/15/05
Well I.D.: MW2296-6-0405	Well Diameter: 2 3 @ 6 8 ___
Total Well Depth: 19.94	Depth to Water Pre: 6.65 Post: 7.10
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: PVC Grade	Flow Cell Type: YSI 556

Purge Method: 2" Grundfos Pump | Peristaltic Pump | Bladder Pump 9:30
Sampling Method: Dedicated Tubing | Disposable Bailer | Other ___
Flow Rate: 2 GPM
Pump Depth: 18'

8.6 (Gals.) X 3 = 25.8 Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
921	- Start	Purge						
924	22.34	7.16	2511	76	0.12	-30.4	6	
926	22.34	7.17	2517	6	0.11	-38.4	10	
928	22.34	7.16	2459	5	0.10	-47.2	14	
930	22.34	7.17	2419	3	0.11	-57.3	18	
932	22.32	7.16	2396	3	0.10	-59.3	22	
934	22.30	7.17	2357	2	0.10	-61.7	26	

Did well dewater? Yes (No) Amount actually evacuated: 26
Sampling Time: 940 Sampling Date: 4/15/05 Depth to Water: 7.10
Sample I.D.: MW2296-6-0405 Laboratory: APCL
Analyzed for: TPH-G BTEX MTBE (TPH-D) Other: See SOW
Equipment Blank I.D.: @ Time Duplicate I.D.:

BLAINE
TECH SERVICES, INC

1680 ROGERS AVENUE
SAN JOSE, CALIFORNIA 95112-1105
FAX (408) 573-7771
PHONE (408) 573-0555

CONDUCT ANALYSIS TO DETECT

[redacted]

APCL COC 1 of 1
(626) 440-4000 Fax: (626) 440-6200
C. Zicker
100 W Walnut Ave.
Pasadena CA 91124

CHAIN OF CUSTODY

CLIENT: Parsons

SITE: Camp Pendleton Area 22 - Site 2296

Global ID: T0607301596

job# 933868 PO# 04000

Disposal by APCL
QC requirement : AFCEE

SAMPLE I.D.	DATE	TIME	MATRIX AQ = H2O	CONTAINERS #	Preservation	Type	TPH-D 8015	Sulfate, Nitrate, Ferrous Iron, Alkalinity 300	RSK175 Methane	PAHs (8270C)	BTEX & MTBE (8260B)	ADD'L INFORMATION	STATUS	CONDITION	LAB SAMPLE #
MW2296-1-0405	4/15/05	1005	AQ	5	None	A, P, V	X	X	X						
MW2296-2-0405		846					X	X	X						
MW2296-3-0405		1018					X	X	X						
MW2296-5-0405		1055					X	X	X	X					
MW2296-6-0405		940		5			X	X	X						
~~TB-05-0405~~	~~4/15/05~~	~~700~~	~~AQ~~	~~2~~	~~HCl~~	~~VOA~~					X				

SAMPLING COMPLETED: DATE 4/15/05 TIME 1100

SAMPLING PERFORMED BY: Chris Davis

RESULTS NEEDED NO LATER THAN: Standard TAT

RELEASED BY	TIME	RECEIVED BY	DATE	TIME
Chris Davis	1240	[redacted]	4-15-05	1240
[redacted]	14:00	[redacted]	4/15/05	1700

SHIPPED VIA | TIME SENT | COOLER #

04/15/2005 17:13 9095901498 APCL PAGE 01

NON-HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. CA2170023533 | Manifest Document No. 17384 | 2. Page 1 of 1

3. Generator's Name and Mailing Address: United States Marine Corps XC/S Environmental Security, Att: Chuck Devine, P.O. Box 555006, Camp Pendleton CA 92055 | CA 17384

4. Generator's Phone (760) 725-5617

5. Transporter 1 Company Name: ECOLOGY CONTROL INDUSTRIES | 6. US EPA ID Number: CAD982030173 | A. Transporter's Phone: 310 320-2565

7. Transporter 2 Company Name | 8. US EPA ID Number | B. Transporter's Phone

9. Designated Facility Name and Site Address: CROSBY & OVERTON, 1630 W. 17TH STREET, LONG BEACH CA 90813 | 10. US EPA ID Number: CAD028409019 | C. Facility's Phone: 562 432-5445

11. Waste Shipping Name and Description	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol
a. Non Hazardous Waste, Liquid (Groundwater)	001	TT	1000	G
b.				
c.				
d.				

D. Additional Descriptions for Materials Listed Above: (L) Profile# 08627

E. Handling Codes for Wastes Listed Above: 15

15. Special Handling Instructions and Additional Information
24 Hour Emergency # 1-800-321-5479
ECI Job #5069 PO# 733868

16. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to federal regulations for reporting proper disposal of Hazardous Waste.

Printed/Typed Name	Signature	Month	Day	Year
Margo Williams	Margo Williams	10	18	05

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year
Rodolfo Costich		10	18	05

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of waste materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Month	Day	Year
Joe Simone		10	18	05

GENERATOR — TRANSPORTER — FACILITY

ORIGINAL - RETURN TO GENERATOR

0421052

ECI ///
Ecology Control Industries
A FULL SERVICE ENVIRONMENTAL COMPANY

DW 4/21/05

TRANSPORTATION SERVICE ORDER

SERVICE ORDER # 288324 5069

DATE: 04/18/05

CUSTOMER

Name: PARSONS ENGINEERING Job Location: Camp Pendleton Ocean Side

Address (BILLING): City: Zip:

Ordered by: Company: P.O. #:

DRIVER

Name (PRINT): Adolfo Castro Signed: Adolfo Castro

Truck #: 22008 Trailer #: Size/Type: V Truck

SERVICES

Services performed: report to Camp Pendleton in Ocean Side Ca for work as directed pump out a total of 1000 gallons of ground water for monitor well load up and transport to Crosby Overton in Long Beach Ca complete job return to ECI Torrance yard

TIME

MANIFEST #: DISPOSAL #:
# #
# #
#Loads: Qty:
BBL: Gal: Tons: Yards:

Start 0500 AM/PM Stop: 1300 AM/PM — Gross Time: 8 Hrs.
MEALS: Start — AM/PM Stop: — AM/PM — Less: — Hrs.
Other Time: Add/Deduct — Total: 8 Hrs.

SITE

Time In: Time In: Time In: Stop Miles:
Start Miles:
Time Out: Time Out: Time Out: Miles Driven:

DESCRIPTION

	QTY.	U.O.M.	RATE	EXT.		QTY.	U.O.M.	RATE	EXT.
Vacuum Truck	8		65	520.00	Disposal				270.00
End Dump					Washout				
Roll-off					Roper Pump				
Flat Bed					Bin Liner				
Tank Mover					Surcharge				
Driver Relief									
Subsistence									

ENTERED APR 27 2005 PAYROLL

Authorized & Approved by: [signature] PARSONS Title: GEOLOGIST

TOTAL CHARGES: $ 790.00

If invoice is not paid within 30 days, interest shall commence accruing at 1.5% per month. Should suit be commenced to collect any portion of this invoice, Ecology Control Industries shall be entitled to any costs deemed reasonable by the court, including attorney fees.

Original: Accounting *Yellow: Accounting* *Pink: Customer* *Gold: Driver* TSO-1

APPENDIX C

LABORATORY REPORTS

Applied P & CH Laboratories
13760 Magnolia Ave., Chino, CA 91710
Tel: (909) 590-1828 Fax: (909) 590-1498

APCL Analytical Report

Submitted to:
Parsons Engineering Science
Attention: Cindy Zicker
100 W. Walnut Street
Pasadena CA 91124
Tel: (626)585-6000 Fax: (626)440-6200

Service ID #: 801-052336
Collected by: CD
Collected on: 04/15/05

Received: 04/15/05
Extracted: 04/19-20/05
Tested: 04/15-26/05
Reported: 04/28/05

Sample Description: Water from Area 22-Site 2296
Project Description: Camp Pendleton

Analysis of Water Samples

Component Analyzed	Method	Unit	PQL	MDL	Analysis Result MW2296-1-0405 05-02336-1	MW2296-2-0405 05-02336-2
ALKALINITY	310.1	mg/L	2	0.93	1,800	300
Dilution Factor					100	20
NITRATE AS N	300.0	mg/L	0.06	0.020	3.6J	2.2
SULFATE	300.0	mg/L	0.5	0.16	300	75
Dilution Factor					1	1
IRON (II)	SM3500DFE-	mg/L	0.05	0.012	0.074	< 0.05
Dilution Factor					0.96	0.96
DIESEL	M8015E	mg/L	0.1	0.013	< 0.096	0.033J
Dilution Factor					1	1
METHANE	RSK175	µg/L	3	0.55	17	13

Component Analyzed	Method	Unit	PQL	MDL	Analysis Result MW2296-3-0405 05-02336-3	MW2296-5-0405 05-02336-4	MW2296-6-0405 05-02336-5
ALKALINITY	310.1	mg/L	2	0.93	1,500	600	580
Dilution Factor					200	50	20
NITRATE AS N	300.0	mg/L	0.06	0.020	6.7J	1.4J	4.7
SULFATE	300.0	mg/L	0.5	0.16	650	150	95
Dilution Factor					1	1	1
IRON (II)	SM3500DFE-	mg/L	0.05	0.012	< 0.05	< 0.05	0.086
Dilution Factor					0.96	0.96	0.96
DIESEL	M8015E	mg/L	0.1	0.013	0.075J	3.7	< 0.096
Dilution Factor					5	100	1
METHANE	RSK175	µg/L	3	0.55	100	2,000	5.6

Applied P & CH Laboratories
13760 Magnolia Ave., Chino, CA 91710
Tel: (909) 590-1828 Fax: (909) 590-1498

APCL Analytical Report

Component Analyzed	Method	Unit	PQL	MDL	Analysis Result MW2296-5-0405 05-02336-4
SEMI-VOC, 64 COMPOUNDS					
Dilution Factor					10
ACENAPHTHENE	SW8270C	µg/L	10	1.5	< 100
ACENAPHTHYLENE	SW8270C	µg/L	10	1.6	< 100
ANTHRACENE	SW8270C	µg/L	10	1.5	< 100
BENZ(A)ANTHRACENE	SW8270C	µg/L	10	1.5	< 100
BENZO(A)PYRENE	SW8270C	µg/L	10	1.2	< 100
BENZO(B)FLUORANTHENE	SW8270C	µg/L	10	1.9	< 100
BENZO(G,H,I)PERYLENE	SW8270C	µg/L	10	1.2	< 100
BENZO(K)FLUORANTHENE	SW8270C	µg/L	10	1.5	< 100
CHRYSENE	SW8270C	µg/L	10	1.4	< 100
DIBENZ(A,H)ANTHRACENE	SW8270C	µg/L	10	1.2	< 100
FLUORANTHENE	SW8270C	µg/L	10	1.6	< 100
FLUORENE	SW8270C	µg/L	10	2.0	< 100
INDENO(1,2,3-CD)PYRENE	SW8270C	µg/L	10	1.1	< 100
2-METHYLNAPHTHALENE	SW8270C	µg/L	10	2.0	< 100
NAPHTHALENE	SW8270C	µg/L	10	2.0	< 100
PHENANTHRENE	SW8270C	µg/L	10	1.7	< 100
PYRENE	SW8270C	µg/L	10	0.68	< 100

PQL: Practical Quantitation Limit. MDL: Method Detection Limit. CRDL: Contract Required Detection Limit

N.D.: Not Detected or less than the practical quantitation limit. "-": Analysis is not required.

J: Reported between PQL and MDL.

Listed Dilution Factors (DF) are relative to the method default DF. All unlisted DFs are 1.0

Respectfully submitted,

Dominic Lau
Laboratory Director
Applied P & CH Laboratories

BLAINE
TECH SERVICES, INC.

1680 ROGERS AVENUE
SAN JOSE, CALIFORNIA 95112-1105
FAX (408) 573-7771
PHONE (408) 573-0555

CONDUCT ANALYSIS TO DETECT

LAB APCL COC 1 of 1

Parsons (626) 440-4000 Fax: (626) 440-6200
C. Zicker
100 W Walnut Ave.
Pasadena CA 91124

CHAIN OF CUSTODY

CLIENT Parsons

SITE Camp Pendleton Area 22 - Site 2296

Global ID T0607301596

job# 933868 PO# 04000

Disposal by APCL
QC requirement : AFCEE

SAMPLE I.D.	DATE	TIME	MATRIX AQ = H2O	CONTAINERS #	Preservation	Type	TPH-D 8015		Sulfate, Nitrate, Ferrous Iron, Alkalinity 300	RSK175 Methane	PAHs (8270C)	BTEX & MTBE (8260B)			ADD'L INFORMATION	STATUS	CONDITION	LAB SAMPLE #
MW2296-1-0405	4/15/05	1005	AQ	5	NONE	A,P,V	X		X	X								
MW2296-2-0405		846					X		X	X					2296			
MW 2296-3-0405		1018					X		X	X								
MW2296-5-0405		1055					X		X	X	X							
MW2296-6-0405		940		5			X		X	X								
~~TB-05-0405~~	~~4/15/05~~	~~700~~	~~AQ~~	~~2~~	~~HCl~~	~~VOA~~						X						

SAMPLING COMPLETED DATE 4/15/05 TIME 1100

SAMPLING PERFORMED BY Chris Davis

RESULTS NEEDED NO LATER THAN Standard TAT

RELEASED BY	TIME	RECEIVED BY	DATE	TIME
Chris Davis	1240		4-15-05	1240
	14:00		4/15/05	1700

SHIPPED VIA | TIME SENT | COOLER #

Applied P & CH Laboratories
13760 Magnolia Ave., Chino CA 91710
Tel: (909) 590-1828 Fax: (909) 590-1498

Sample Receiving Checklist

APCL ServiceID: 2336 Client Name/Project: Parsons

1. Sample Arrival

Date/Time Received 4/15/05 1700 Date/Time Opened 4/15/05 1700 By (name) Jason

Custody Transfer: ☐ Client ☐ Golden State ☐ UPS ☐ US Mail ☐ FedEx ☒ APCL Empl: RS

2. Chain-of-Custody (CoC)

☒ With Samples? ☐ Faxed? ☒ Client has Copy? ☒ Signed, dated? By: _____

☒ Project ID? ☒ Analyses Clear? ☐ Hold Samples? #on Hold _____ # Received _____

☐ CoC/Docs Zip-Locked under lid? ☐ Compos.#: _ ☒ #Samples OK? _____

☐ Sampled By : _____

3. Shipping Container/Cooler

☒ Cooler Used? # of 1 Cooled by: ☒ Ice ☐ Blue Ice ☐ Dry Ice ☐ None

Temp °C 3.0 _____ _____ _____ _____ _____

(Cooler temperature measured from temp blank if present, otherwise measured from the cooler).

Cooler Custody Seal? ☐ Absent ☐ Intact ☐ Tampered?

4. Sample Preservation

☐ pH <2 ☐ pH >12

If Not, pH = _____ Preserved by: ☐ Client ☐ APCL ☐ Third Party _____

5. Holding-time Requirements

☐ pH 24hr ☐ BACT 6/24hr ☐ Cr^{VI} 24hr ☐ NO_3^- 48hr ☐ BOD 48hr

☐ Cl_2 ASAP ☐ Turbidity 48hr ☐ DO ASAP ☐ Fe(II) ASAP

☐ HT Expired? ☐ Client notified?

6. Sample Container Condition

☒ Intact? ☐ Broken? ☐ Anomalies Documented?

Type: ☐ plastic ☒ glass ☐ Tube: brass/SS ☐ Tedlar Bag

☐ Quantity OK? ☐ Leaking? ☐ Appropriate for specific method?

☐ Caps tight? ☐ Air Bubbles? ☐ Adequate Volume?

Labels: ☐ Unique ID? ☐ Date/Time ☐ Label and ink intact?

7. Turn Around Time

☒ RUSH TAT: _____ ☐ Std (7-10 days) ☐ Not Marked

8. Sample Matrix

☐ Drinking H_2O ☒ Other Liq ☐ Soil ☐ Wipe ☐ Polymer ☐ Air ☐ Other: _____

☐ Ground H_2O ☐ Sludge ☐ Filter ☐ Oil/Petro ☐ Paint ☐ W. Water ☐ Extract ☐ Unknown

9. Pre-Login Check List Completed & OK?

☒ ALL OK? (if not, see SOP C-11) ☐ Client Contact? (Name:_____)Date/Time:_____

Received/Checked by: _____ Printed: 15 Apr 2005 8:21 a.m.

*HT: Samples must be analyzed for results to reflect total concentrations. Results generated outside required of holding times are considered minimal values and may be used to define waste as hazardous but not as non-hazardous.

DocumentFile: [eval.texfiles]smprcl.tex.

Applied P & CH Laboratories

Organic Analysis Results for Method SW8270C

Client Name:	Parsons Engineering Science	Project No:		Collection Date:	04/20/2005
Project ID:	Camp Pendleton	Service ID:	52336	Collected by:	
		Lab Sample ID:	05G1855-MB-01	Received Date:	04/20/2005
Sample ID:	**05G1855-MB-01**	Sample Matrix	Water	Moisture %:	–
Sample Type:	Method Blank	Prep. Method:	3510	Instrument ID:	GC/MS: Y
Anal. Method:	SW8270C	Prep. Date:	04/20/05	Anal. Date:	04/26/05
Batch No:	05G1855	Prep. No:	1 of 1	Anal. Time:	12:03
Data File Name:	G1855K01	Sample Amount:	1000 mL	Dilution Factor:	1
Extract Vol.	1.0 mL				

#	Component Name	CAS No	Unit	RL	Result	Qualifier
1	ACENAPHTHENE	83-32-9	µg/L	10	< 10	U
2	ACENAPHTHYLENE	208-96-8	µg/L	10	< 10	U
3	ANTHRACENE	120-12-7	µg/L	10	< 10	U
4	BENZ(A)ANTHRACENE	56-55-3	µg/L	10	< 10	U
5	BENZO(A)PYRENE	50-32-8	µg/L	10	< 10	U
6	BENZO(B)FLUORANTHENE	205-99-2	µg/L	10	< 10	U
7	BENZO(G,H,I)PERYLENE	191-24-2	µg/L	10	< 10	U
8	BENZO(K)FLUORANTHENE	207-08-9	µg/L	10	< 10	U
9	CHRYSENE	218-01-9	µg/L	10	< 10	U
10	DIBENZ(A,H)ANTHRACENE	53-70-3	µg/L	10	< 10	U
11	FLUORANTHENE	206-44-0	µg/L	10	< 10	U
12	FLUORENE	86-73-7	µg/L	10	< 10	U
13	INDENO(1,2,3-CD)PYRENE	193-39-5	µg/L	10	< 10	U
14	2-METHYLNAPHTHALENE	91-57-6	µg/L	10	< 10	U
15	NAPHTHALENE	91-20-3	µg/L	10	< 10	U
16	PHENANTHRENE	85-01-8	µg/L	10	< 10	U
17	PYRENE	129-00-0	µg/L	10	< 10	U

Surrogates			Control Limit, %	Surro. Rec.%
1	2-FLUOROBIPHENYL	321-60-8	40-129	92
2	2-FLUOROPHENOL	367-12-4	20-119	48
3	NITROBENZENE-D5	4165-60-0	40-128	69
4	PHENOL-D5	4165-62-2	10-110	26
5	TERPHENYL-D14	1718-51-0	40-134	71
6	2,4,6-TRIBROMOPHENOL	118-79-6	20-129	93
# of out-of-control				0

Internal Standard			Control Limit, %	IS Rec.%
1	ACENAPHTHENE-D10	15067-26-2	50-200	75
2	CHRYSENE-D12	1719-03-5	50-200	151
3	1,4-DICHLOROBENZENE-D4	3855-82-1	50-200	110
4	NAPHTHALENE-D8	1146-65-2	50-200	109
5	PERYLENE-D12	1520-96-3	50-200	87
6	PHENANTHRENE-D10	1517-22-2	50-200	108
# of out-of-control				0

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Qualifier: U - Not Detected or less than MDL/IDL
F - Positively identified, but Less than RL
M - A matrix effect was present
T - TIC by GC/MS
E - Exceed calibration range
B - Analyte is detected in the associated method blank
J - Positively identified, the quantitaion is estimated
R - unusable due to deficiencies

FORM-2C

Applied P & CH Laboratories

Surrogate Recovery Summary for Method SW8270C

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	052336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05G1855		

#	Client Sample No	Lab Sample ID	S1 %	#	S2 %	#	S3 %	#	S4 %	#	S5 %	#	S6 %	#	TOT OUT
1	05G1855-LCS-01	05G1855-LCS-01	54		41		55		29		61		79		0
2	05G1855-LSD-01	05G1855-LSD-01	51		42		55		29		59		77		0
3	05G1855-MB-01	05G1855-MB-01	92		48		69		26		71		93		0
4	MW2296-5-0405	05-2336-4	83		46		83		27		91		122		0
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															

	QC Control Limit
S1 = 2-FLUOROBIPHENYL	40-129
S2 = 2-FLUOROPHENOL	20-119
S3 = NITROBENZENE-D5	40-128
S4 = PHENOL-D5	10-110
S5 = TERPHENYL-D14	40-134
S6 = 2,4,6-TRIBROMOPHENOL	20-129

Column to be used to flag recovery values:

* - Values outside of contract required QC Limits D – Surrogate diluted out I – Matrix Interference

FORM-3C

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method SW8270C

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05G1855		
LCS Filename:	G1855L01	Date Analyzed:	042605	Time Analyzed:	10:46
LCSD Filename:	G1855J01	Date Analyzed:	042605	Time Analyzed:	11:25

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
ACENAPHTHENE	µg/L	50	0	39.5	79	40-112
4-CHLORO-3-METHYLPHENOL	µg/L	100	0	82.4	82	41-105
2-CHLOROPHENOL	µg/L	100	0	60.6	61	44-102
1,4-DICHLOROBENZENE	µg/L	50	0	33.0	66	40-106
2,4-DINITROTOLUENE	µg/L	50	0	46.5	93	40-117
4-NITROPHENOL	µg/L	500	0	121	24	18-144
N-NITROSODI-N-PROPYLAMINE	µg/L	50	0	28.5	57	45-113
PENTACHLOROPHENOL	µg/L	500	0	379	76	27-138
PHENOL	µg/L	100	0	33.4	33	32-102
PYRENE	µg/L	50	0	37.1	74	40-119
1,2,4-TRICHLOROBENZENE	µg/L	50	0	41.0	82	40-108
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
ACENAPHTHENE	µg/L	50	40.1	80	1	39	40-112
4-CHLORO-3-METHYLPHENOL	µg/L	100	84.4	84	2	36	41-105
2-CHLOROPHENOL	µg/L	100	59.5	60	2	36	44-102
1,4-DICHLOROBENZENE	µg/L	50	32.8	66	0	37	40-106
2,4-DINITROTOLUENE	µg/L	50	46.0	92	1	40	40-117
4-NITROPHENOL	µg/L	500	114	23	4	65	18-144
N-NITROSODI-N-PROPYLAMINE	µg/L	50	27.9	56	2	39	45-113
PENTACHLOROPHENOL	µg/L	500	398	80	5	61	27-138
PHENOL	µg/L	100	33.9	34	3	36	32-102
PYRENE	µg/L	50	36.1	72	3	38	40-119
1,2,4-TRICHLOROBENZENE	µg/L	50	41.3	83	1	35	40-108
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

_____

FORM-4B

Applied P & CH Laboratories

Method Blank Summary for Method SW8270C

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Analysis Date:	04/26/05
		Sample Matrix:	Water	Analysis Time:	12:03
Sample ID:	**05G1855-MB-01**	Batch No:	05G1855	Instrument ID:	GC/MS: Y
Lab Sample ID:	05G1855-MB-01	Data File Name:	G1855K01	GC Column:	DB-5.625
				Column ID:	0.25 mm

This Method Blank applies to the following samples and QC samples:

#	Client Sample No	Lab Sample ID	Sample Type	Data Filename	Analysis Date	Analysis Time
1	05G1855-LCS-01	05G1855-LCS-01	Lab Control Spike	G1855L01	04/26/05	10:46
2	05G1855-LSD-01	05G1855-LSD-01	Lab Control Spike Duplicate	G1855J01	04/26/05	11:25
3	MW2296-5-0405	05-2336-4	Field Sample	2336-04	04/26/05	14:48
4						
5						
6						
7						
8						
9						
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22						
23						
24						
25						

Applied P & CH Laboratories

Organic Analysis Results for Method M8015E

Client Name:	Parsons Engineering Science	Project No:		Collection Date:	04/19/2005
Project ID:	Camp Pendleton	Service ID:	52336	Collected by:	
		Lab Sample ID:	05G1844-MB-01	Received Date:	04/19/2005
Sample ID:	05G1844-MB-01	Sample Matrix	Water	Moisture %:	–
Sample Type:	Method Blank	Prep. Method:	3510	Instrument ID:	GC: W
Anal. Method:	M8015E	Prep. Date:	04/19/05	Anal. Date:	04/21/05
Batch No:	05G1844	Prep. No:	1 of 1	Anal. Time:	23:57
Data File Name:	1844G.K01	Sample Amount:	1000 mL	Dilution Factor:	1
Extract Vol.	1.0 mL				

#	Component Name	CAS No	Unit	RL	Result	Qualifier
1	DIESEL	11-84-7	mg/L	0.1	<0.1	U

Surrogates			Control Limit, %	Surro. Rec.%
1	OCTACOSANE, C28	630-02-4	57-139	91
# of out-of-control				0

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

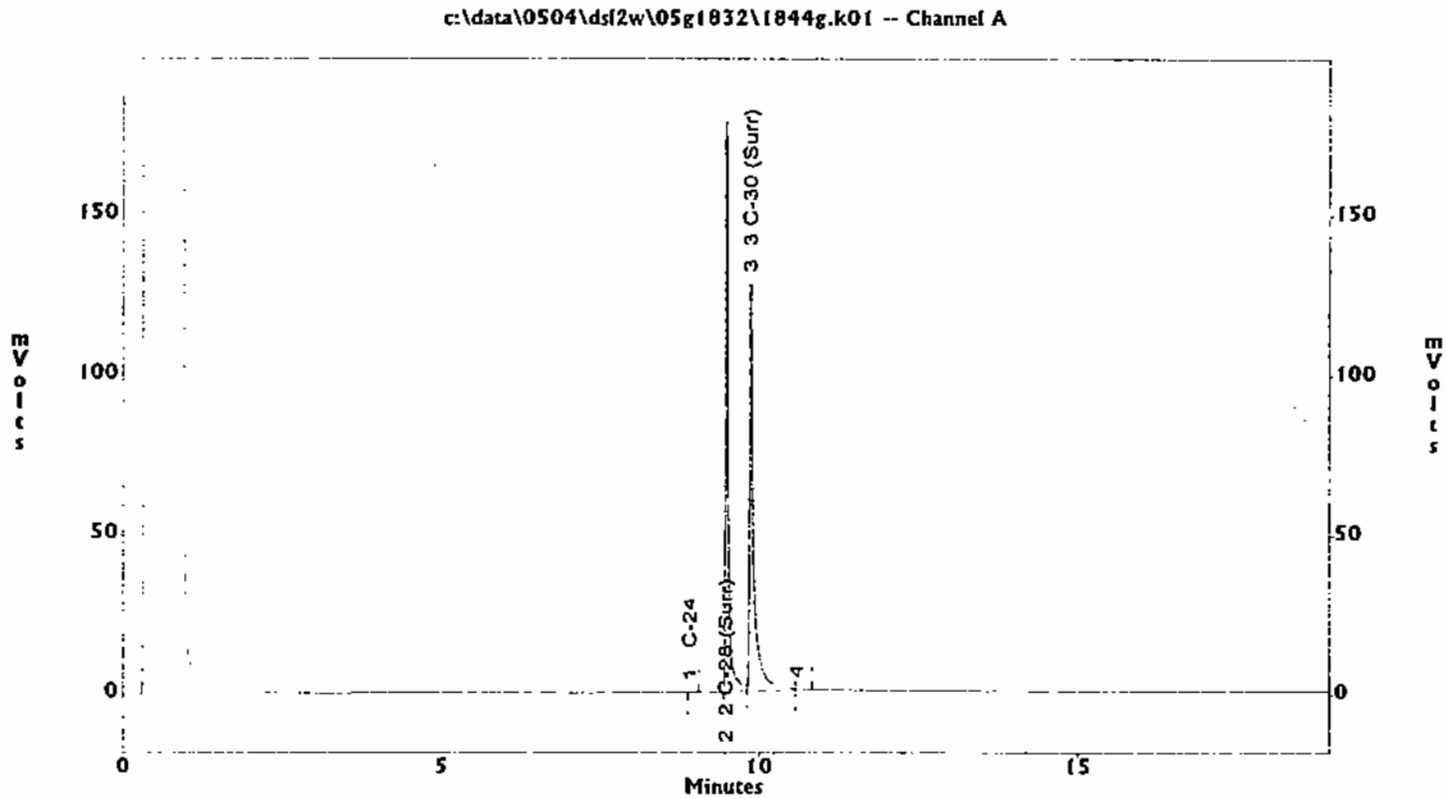
Qualifier: U - Not Detected or less than MDL/IDL
F - Positively identified, but Less than RL
M - A matrix effect was present
T - TIC by GC/MS
E - Exceed calibration range
B - Analyte is detected in the associated method blank
J - Positively identified, the quantitaion is estimated
R - unusable due to deficiencies

Applied P & Ch Lab
Total Extractable Petroleum Hydrocarbon Analysis by GC-FID
Instrument ID: GC-W, Column: DB-1 (0.32mm x 15m x 0.25 um), 1ul

File : c:\data\0504\ds12w\05g1832\1844g.k01
Method : c:\ezchrom\methods\Ds12-056.w00
Sample ID : mb f=0.001
Vial : 1
Volume : 2
Acquired : Apr 21, 2005 23:57:39
Printed : Apr 22, 2005 00:16:39
User : Linda Liang
File Desc. : Continue

Channel A Results

Name	Time	Area	AVE RF	Conc (ppm)
C-10	3.59	0	0.000	0.000
C-16	6.63	0	0.000	0.000
C-22	8.32	0	0.000	0.000
C-24	8.92	1271	0.000	0.000
2 C-28 (Surr)	9.48	487816	10757.817	45.345
3 C-30 (Surr)	9.87	539795	10638.618	50.739
C-36	12.12	0	0.000	0.000
1 Diesel c10-c24		0	12992.507	0.000
4 Motor oil c24-c36		4454	5674.990	0.785
5 JP5 c8-c16		0	12037.801	0.000



FORM-2C

Applied P & CH Laboratories

Surrogate Recovery Summary for Method M8015E

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		SDG Number:	052336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05G1844		

#	Client Sample No	Lab Sample ID	S1 %	#	TOT OUT
1	05G1844-LCS-01	05G1844-LCS-01	111		0
2	05G1844-LSD-01	05G1844-LSD-01	117		0
3	05G1844-MB-01	05G1844-MB-01	91		0
4	MW2296-2-0405	05-2336-2	118		0
5	MW2296-3-0405	05-2336-3	96		0
6	MW2296-5-0405	05-2336-4	93		0
7	MW2296-6-0405	05-2336-5	113		0
8	MW2296-1-0405	05-2336-1	98		0
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

	QC Control Limit
S1 = N-OCTACOSANE	57-139

Column to be used to flag recovery values:

* – Values outside of contract required QC Limits D – Surrogate diluted out I – Matrix Interference

FORM-3C

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method M8015E

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05G1844		
LCS Filename:	1844G.L01	Date Analyzed:	042105	Time Analyzed:	23:06
LCSD Filename:	1844G.J01	Date Analyzed:	042105	Time Analyzed:	23:32

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
DIESEL	mg/L	1	0	0.968	97	56-129
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
DIESEL	mg/L	1	1.03	103	6	49	56-129
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* - Values outside of contract required QC Limits D - Spiked components diluted out

Comments: _____

_____

Applied P & CH Laboratories

Organic Analysis Results for Method RSK175

Client Name:	Parsons Engineering Science	Project No:		Collection Date:	04/20/2005
Project ID:	Camp Pendleton	Service ID:	52336	Collected by:	
		Lab Sample ID:	05G1854-MB-01	Received Date:	04/20/2005
Sample ID:	05G1854-MB-01	Sample Matrix	Water	Moisture %:	--
Sample Type:	Method Blank	Prep. Method:	-	Instrument ID:	GC: K
Anal. Method:	RSK175	Prep. Date:	-	Anal. Date:	04/20/05
Batch No:	05G1854	Prep. No:	-	Anal. Time:	14:13
Data File Name:	1854G.K01	Sample Amount:	33 mL	Dilution Factor:	1
Extract Vol.	-				

#	Component Name	CAS No	Unit	RL	Result	Qualifier
1	METHANE	74-82-8	µg/L	3	<3	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Qualifier: U - Not Detected or less than MDL/IDL
F - Positively identified, but Less than RL
M - A matrix effect was present
T - TIC by GC/MS
E - Exceed calibration range
B - Analyte is detected in the associated method blank
J - Positively identified, the quantitaion is estimated
R - unusable due to deficiencies

FORM-3C

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method RSK175

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05G1854		
LCS Filename:	1854G.L01	Date Analyzed:	042005	Time Analyzed:	13:51
LCSD Filename:	1854G.J01	Date Analyzed:	042005	Time Analyzed:	13:54

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
METHANE	µg/L	19.8	0	17.8	90	65-122
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
METHANE	µg/L	19.8	17.4	88	2	34	65-122
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

_____

FORM-3C

Applied P & CH Laboratories

Matrix Spike/Matrix Spike Duplicate Recovery for Method RSK175

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05G1854		
MS Filename:	1854G.M01	Date Analyzed:	042005	Time Analyzed:	15:16
MSD Filename:	1854G.N01	Date Analyzed:	042005	Time Analyzed:	15:19
MS Sample No:	**MW22187-10A-0405**	Sample Lab ID:	05-2314-5		

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration MS	MS Rec% #	QC Limit, % REC
METHANE	µg/L	19.8	0	16.9	85	65-132
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	MSD Concentration	MSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
METHANE	µg/L	19.8	16.7	84	1	34	65-132
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

_____

FORM-4B

Applied P & CH Laboratories

Method Blank Summary for Method RSK175

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Analysis Date:	04/20/05
		Sample Matrix:	Water	Analysis Time:	14:13
Sample ID:	**05G1854-MB-01**	Batch No:	05G1854	Instrument ID:	GC: K
Lab Sample ID:	05G1854-MB-01	Data File Name:	1854G.K01	GC Column:	GSQ
				Column ID:	0.53 mm

This Method Blank applies to the following samples and QC samples:

#	Client Sample No	Lab Sample ID	Sample Type	Data Filename	Analysis Date	Analysis Time
1		05G1854LCS01	Lab Control Spike	G1854L01	04/20/05	13:51
2		05G1854LSD01	Lab Control Spike Duplicate	G1854J01	04/20/05	13:54
3	MW2296-1-0405	05-2336-1	Field Sample	2336.001	04/20/05	14:44
4	MW2296-2-0405	05-2336-2	Field Sample	2336.002	04/20/05	14:52
5	MW2296-3-0405	05-2336-3	Field Sample	2336.103	04/20/05	14:59
6	MW2296-5-0405	05-2336-4	Field Sample	2336.104	04/20/05	15:10
7	MW22187-10A-0405MS	05-2314-5MS	Matrix Spike	1854G.M01	04/20/05	15:16
8	MW2296-6-0405	05-2336-5	Field Sample	2336.005	04/20/05	15:14
9	MW22187-10A-0405MSD	05-2314-5MSD	Matrix Spike Duplicate	1854G.N01	04/20/05	15:19
10						
11						
12						
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14						
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23						
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25						

Applied P & CH Laboratories

Wet Analysis Results for Method 310.1

Client Name: Parsons Engineering Science | Project No: | Anal. Method 310.1
Project ID: Camp Pendleton | Service ID: 52336 | Collected by: CD

Component Name: Alkalinity
CAS No: 10-09-3

Lab ID	Sample ID	Matrix	Coll. Date	Rcv Date	Anal. Date	Batch	Unit	RL	Result	Q
05-2336-1	MW2296-1-0405	Water	04/15/05	04/15/05	04/19/05	05W2115	mg/L	2	1800	
05-2336-2	MW2296-2-0405	Water	04/15/05	04/15/05	04/19/05	05W2115	mg/L	2	300	
05-2336-3	MW2296-3-0405	Water	04/15/05	04/15/05	04/19/05	05W2115	mg/L	2	1500	
05-2336-4	MW2296-5-0405	Water	04/15/05	04/15/05	04/19/05	05W2115	mg/L	2	600	
05-2336-5	MW2296-6-0405	Water	04/15/05	04/15/05	04/19/05	05W2115	mg/L	2	580	
05W2115-MB-01	05W2115-MB-01	Water	04/19/05	04/19/05	04/19/05	05W2115	mg/L	2	<2	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Note: Q - Qualifier.
Qualifier: U - Not Detected or less than MDL
F - Less than RL (PQL, EQL or CRDL), but greater than MDL.

Applied P & CH Laboratories

Wet Analysis Results for Method 300.0

Client Name: Parsons Engineering Science | Project No: | Anal. Method 300.0
Project ID: Camp Pendleton | Service ID: 52336 | Collected by: CD

Component Name: Nitrate as N
CAS No: 14797-55-8

Lab ID	Sample ID	Matrix	Coll. Date	Rcv Date	Anal. Date	Batch	Unit	RL	Result	Q
05-2336-1	MW2296-1-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	6	3.6	F
05-2336-2	MW2296-2-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	1.2	2.2	
05-2336-3	MW2296-3-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	12	6.7	F
05-2336-4	MW2296-5-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	3	1.4	F
05-2336-5	MW2296-6-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	1.2	4.7	
05W2074-MB-01	05W2074-MB-01	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	0.06	<0.06	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Note: Q - Qualifier.
Qualifier: U - Not Detected or less than MDL
F - Less than RL (PQL, EQL or CRDL), but greater than MDL.

Applied P & CH Laboratories

Wet Analysis Results for Method 300.0

Client Name: Parsons Engineering Science | Project No: | Anal. Method 300.0
Project ID: Camp Pendleton | Service ID: 52336 | Collected by: CD

Component Name: Sulfate
CAS No: 14808-79-8

Lab ID	Sample ID	Matrix	Coll. Date	Rcv Date	Anal. Date	Batch	Unit	RL	Result	Q
05-2336-1	MW2296-1-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	50	300	
05-2336-2	MW2296-2-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	10	75	
05-2336-3	MW2296-3-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	100	650	
05-2336-4	MW2296-5-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	25	150	
05-2336-5	MW2296-6-0405	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	10	95	
05W2074-MB-01	05W2074-MB-01	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	0.5	<0.5	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Note: Q - Qualifier.
Qualifier: U - Not Detected or less than MDL
F - Less than RL (PQL, EQL or CRDL), but greater than MDL.

Applied P & CH Laboratories

Wet Analysis Results for Method SM3500DFE-

Client Name: Parsons Engineering Science | Project No: | Anal. Method SM3500DFE-
Project ID: Camp Pendleton | Service ID: 52336 | Collected by: CD

Component Name: Iron (II)
CAS No:

Lab ID	Sample ID	Matrix	Coll. Date	Rcv Date	Anal. Date	Batch	Unit	RL	Result	Q
05-2336-1	MW2296-1-0405	Water	04/15/05	04/15/05	04/15/05	05W2069	mg/L	0.05	0.074	
05-2336-2	MW2296-2-0405	Water	04/15/05	04/15/05	04/15/05	05W2069	mg/L	0.05	<0.05	U
05-2336-3	MW2296-3-0405	Water	04/15/05	04/15/05	04/15/05	05W2069	mg/L	0.05	<0.05	U
05-2336-4	MW2296-5-0405	Water	04/15/05	04/15/05	04/15/05	05W2069	mg/L	0.05	<0.05	U
05-2336-5	MW2296-6-0405	Water	04/15/05	04/15/05	04/15/05	05W2069	mg/L	0.05	0.086	
05W2069-MB-01	05W2069-MB-01	Water	04/15/05	04/15/05	04/15/05	05W2069	mg/L	0.05	<0.05	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Note: Q - Qualifier.
Qualifier: U - Not Detected or less than MDL
F - Less than RL (PQL, EQL or CRDL), but greater than MDL.

FORM-3

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method 310.1

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05W2115		
LCS Filename:	-	Date Analyzed:	041905	Time Analyzed:	15:19
LCSD Filename:	-	Date Analyzed:	041905	Time Analyzed:	15:19

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
ALKALINITY	mg/L	100	0	102	102	90-110
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
ALKALINITY	mg/L	100	100	100	2	10	90-110
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

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FORM-3

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method 300.0

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05W2074		
LCS Filename:	-	Date Analyzed:	041505	Time Analyzed:	10:03
LCSD Filename:	-	Date Analyzed:	041505	Time Analyzed:	10:15

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
NITRATE AS N	mg/L	1.5	0	1.49	99	86-110
SULFATE	mg/L	15	0	14.6	97	82-110
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
NITRATE AS N	mg/L	1.5	1.50	100	1	13	86-110
SULFATE	mg/L	15	14.6	97	0	17	82-110
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

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FORM-3

Applied P & CH Laboratories

Matrix Spike/Matrix Spike Duplicate Recovery for Method 300.0

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05W2074		
MS Filename:	-	Date Analyzed:	041505	Time Analyzed:	14:25
MSD Filename:	-	Date Analyzed:	041505	Time Analyzed:	14:38
MS Sample No:	**U8-133**	Sample Lab ID:	05-2316-2		

Spiked Components	Unit	Spike Added	Concentration Unspiked	MS	MS Rec% #	QC Limit, % REC
NITRATE AS N	mg/L	37.5	19	57.2	102	86-112
SULFATE	mg/L	375	30	403	99	83-116
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	MSD Concentration	MSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
NITRATE AS N	mg/L	37.5	51.2	86	17 *	13	86-112
SULFATE	mg/L	375	341	83	18 *	17	83-116
# of Out-of-control				0	2		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

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FORM-3

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method SM3500DFE-

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05W2069		
LCS Filename:	-	Date Analyzed:	041505	Time Analyzed:	18:37
LCSD Filename:	-	Date Analyzed:	041505	Time Analyzed:	18:37

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
IRON (II)	mg/L	0.5	0	0.490	98	80-120
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
IRON (II)	mg/L	0.5	0.490	98	0	25	80-120
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* - Values outside of contract required QC Limits D - Spiked components diluted out

Comments: _____

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FORM-3

Applied P & CH Laboratories

Matrix Spike/Matrix Spike Duplicate Recovery for Method SM3500DFE-

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52336
Project ID:	Camp Pendleton	Project No:		Sample Matrix:	Water
		Batch No:	05W2069		
MS Filename:	-	Date Analyzed:	041505	Time Analyzed:	18:37
MSD Filename:	-	Date Analyzed:	041505	Time Analyzed:	18:37
MS Sample No:	MW2296-1-0405	Sample Lab ID:	05-2336-1		

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration MS	MS Rec% #	QC Limit, % REC
IRON (II)	mg/L	0.5	0.074	0.540	93	75-125
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	MSD Concentration	MSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
IRON (II)	mg/L	0.5	0.540	93	0	25	75-125
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* - Values outside of contract required QC Limits D - Spiked components diluted out

Comments: _____

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Wet Chemistry QC Report B
Duplicate Results

Matrix: Water

APCL Service ID: 05-2336

Analysis	Batch ID	Analysis Date	Sample Name	Unit	Result	Duplicate Result	RPD %	RPD Control limit
Alkalinity	05W2115	4/19/05	MW2296-6-0405	mg/L	583.8	589.2	1	20

Note: N/A = Not applicable; NR: Not requested; NC= Not Calculated; ND: Not detected.

APPENDIX D

REGIONAL WATER QUALITY CONTROL BOARD

MEETING NOTES

PARSONS
100 W Walnut St, Pasadena, CA 91124 (626) 440-4000 Fax (626) 440-6200

Meeting Notes

Subject:	**Meeting Notes regarding Project Update Meeting for 8 UST Sites, MCB Camp Pendleton**		
Location:	AC/S ES Office Bldg. 22165, Library Conference Room		
Date:	2/10/2005	Time:	9:00 AM
Project:	UST Sites, Camp Pendleton	Facilitator &	C. Silver, Parsons
Project No.:	733868.01000	Recorded By:	

Attendees Name/Company

Bipin Patel	SWDIV	Laurie Walsh	RWQCB
Chet Storrs	MCB Camp Pendleton AC/S	Cannon Silver	Parsons

Item	Meeting Notes	Action
1.	Parsons gave an overview of site locations, contaminants, cleanup goals, and remediation history.	None.
2.	Discussed EPA Guidance for evaluation of biosparging effectiveness. Discussed recent guidance to maintain DO above 2 mg/L, and efforts to optimize system operation to achieve higher DO. Parsons professional judgment is that sparging pure oxygen would not significantly improve performance. Discussed success in observing oxygen utilization at the sites.	Parsons to use 2 mg/L as DO goal, and to continue to try optimizing system operation to reach this concentration.
3.	Chet clarified that entire Base is within a beneficial use aquifer, but that comparing sites to the EPA guidance on low-risk soil and groundwater sites can be useful as an evaluation of remedial progress. He noted that other sites on Base have been closed even with groundwater monitoring results above MCLs.	Noted.
4.	Discussed Site 22187. Noted that oxygen utilization remains at ~1%/day, suggesting that continued biosparging may be useful in removing residual biodegradable petroleum hydrocarbons within the vadose zone.	Biosparging will continue at Site 22187 until a further reduction in oxygen utilization is observed. Parsons to use multiple lines of evidence to evaluate system performance, including accepted models such as Bioscreen™. Post remediation monitoring will include one year of groundwater monitoring and soil confirmation sampling.
5.	Discussed whether analysis for benzene and MTBE may be discontinued at Site 22187. Benzene has not been detected above cleanup	Laurie to ask others at the RWQCB.

Item	Meeting Notes	Action
	goals since April 2002, and MTBE remains well below cleanup goals.	
6.	Discussed Site 2296, including the Response to Comments. Soil borings installed in February 2003 indicated that leachable TPH remained under the street, and remediation during 2004 focused on this area. 2004 soil gas monitoring oxygen utilization rates are now zero, indicating that residual vadose zone soil contamination has now been removed. Benzene MCL has been met, and dissolved-phase TPHd concentrations in MW2296-5 are decreasing.	Parsons to discontinue biosparging system operation. One-year of groundwater monitoring will include April and October 2005 events. After one year, the System Performance Review Report will be submitted, possibly with recommendations for no further action.
7.	Discussed delivery of QA/QC data to RWQCB.	Parsons to send CD with 2nd Quarter 2004 QA/QC data to Camp Pendleton, who will then forward to RWQCB.
8.	The site number reference system was discussed.	Parsons to update numbers on Response to Comments.
9.	Discussed Site 1121. Benzene concentrations are asymptotic in MW1121-8, and non-detect in MW-10A. TPHd continues to fluctuate in MW1121-8 and MW-10A, possibly as a result of BS system operation. Laurie noted that closure may be argued based on the distance to the nearest Base drinking water well (9,300 feet from neighboring Site 1131), that TPHd has only a taste and odor threshold, and that biodegradation is occurring.	Parsons to shutdown biosparging system for one year to see if TPHd concentrations stabilize, perform soil confirmation sampling to document percent reduction, and then present the case for site closure.
10.	Discussed Site 1131. Cleanup goals for benzene have been met. TPHd concentrations continue to fluctuate in MW1131-1, due to submerged residual pockets of petroleum hydrocarbons within the weathered grandiolite. Overall plume is stable. Downgradient well MW1131-8 remains near cleanup goals.	Similar to Site 1121, Parsons to shutdown biosparging system for one year to see if TPHd concentrations stabilize, perform soil confirmation sampling to document percent reduction, and then present the case for site closure.
11.	Discussed Site 43302. TPHd concentrations have increased as groundwater elevations have decreased. Benzene concentrations have continued to decrease. Oxygen utilization continues at ~0.5%/day.	Biosparging will continue at Site 43302 until a further reduction in oxygen utilization is observed. Continue to work on reaching MCL for benzene.
12.	Discussed Site 53435. No benzene at the site. Discussed how increasing TPHd concentrations may be related to the decreasing groundwater elevations or to BS system operation. Suggested turning off the system for 3 months to evaluate	Parsons to turn off the system for 3 months to evaluate whether TPH concentrations stabilize. The 4th Quarter 2004 System and Groundwater Monitoring Report will be revised to

Item	Meeting Notes	Action
	impact on GW concentrations. Soil gas sampling indicates that residual biodegradable petroleum compounds remain in the subsurface. Discussed elevated TPH measured in downgradient MW53435-8. Discussed whether there were two sources and plumes present, based on 1997 soil boring data. Mentioned that the site has a high groundwater velocity. Laurie mentioned that the proximity to the San Onofre Creek is a concern.	include a further evaluation of contamination sources, plume extent, and trends.
Site visits were conducted to 22187, 2296, 1121, 1131, 43302, and 53435. The site visits were concluded at approximately 14:00.		
cc: All participants Martha Araujo, NFESC File		